INTERNATIONAL MONETARY FUND

Can Retail Central Bank Digital Currencies Improve the Delivery of Social Safety Nets?

Denis Nikitin, Johan Schmalholz and Carolina Bloch

WP/25/211

2025
OCT

WORKING PAPER

 WP/25/211

IMF Working Paper
Fiscal Affairs

Can Retail Central Bank Digital Currencies Improve the Delivery of Social Safety Nets?

Prepared by Denis Nikitin, Johan Schmalholz and Carolina Bloch*

Authorized for distribution by Rodrigo Cerda
October 2025

ABSTRACT: This paper explores how retail central bank digital currencies (CBDCs) could enhance the delivery of social safety nets (SSNs). It assesses CBDC design features and their implications for payment administration and delivery. Findings suggest that using CBDCs solely as payment delivery solutions offers limited advantages over existing systems such as faster payment systems. However, leveraging CBDCs as payment administration platforms—with peer-to-peer transfers, decentralized ledger access, and advanced programmability—could transform SSN delivery by enabling agencies to automate transfers, operate independently from private financial intermediaries, and monitor transactions directly. These benefits come with significant challenges, including privacy concerns, compliance risks, and infrastructure requirements. The paper emphasizes that realizing CBDCs' full potential for SSNs will depend on thoughtful integration with existing systems and a clear understanding of their comparative advantages. Aimed at social protection policymakers and finance specialists, it highlights the need for collaboration between CBDC developers and SSN administrators to ensure that digital currencies effectively support inclusive and efficient benefit delivery.

RECOMMENDED CITATION: Denis Nikitin, Johan Schmalholz and Carolina Bloch. (2025) "Can Retail Central Bank Digital Currencies Improve the Delivery of Social Safety Nets?" IMF Working Papers WP/25/211.

JEL Classification Numbers:	I38, E42, E58
Keywords:	Central Bank Digital Currencies, Social Safety Nets, Payment Systems, Government Transfers, Fintech, Financial Inclusion
Author's E-Mail Address:	dnikitin@worldbank.org; johan.schmalholz@riksbank.se; cdubeuxbloch@imf.org

* The authors would like to thank useful comments from Pelin Berkmen, Nicolo Bird, Victor Budau, Patrik Centellini, Ke Chen, Pierre-Adrien Fondja, Tarek Ghani, Borja Gracia, Emine Hanedar, Jiro Honda, Tayo Koonprasert, Antonio Manzanera, Mariano Moszoro, Manabu Nose, Marco Reuter, Lorena Rivero del Paso, Harriet Tolputt, Rui Xu, Paula Zarazinski.

WORKING PAPERS

Can Retail Central Bank Digital Currencies Improve the Delivery of Social Safety Nets?

Prepared by Denis Nikitin, Johan Schmalholz and Carolina Bloch

We gratefully acknowledge the financial support of the Government of Japan for this analytical work.

Contents

FIGURES

TABLES

Executive Summary

The adoption of central bank digital currencies (CBDCs) as payment platforms has, in the long run, the potential to transform financial and payment service delivery, thereby enhancing governments' ability to provide social assistance benefits to poor and vulnerable populations. This paper examines the design features of retail CBDCs (in this paper, CBDCs refer to retail CBDCs only), focusing on the benefits and risks they present for the implementation of social safety nets (SSNs). The impact of CBDCs on SSNs will depend on the design characteristics of CBDC platforms, which can vary widely in functionality.

Key findings indicate that using CBDC platforms narrowly as payment delivery solutions does not lead to dramatic enhancements of SSN delivery relative to existing payment delivery solutions, especially faster payment systems (FPS). However, using CBDC platforms as payment administration solutions has the potential of significantly transforming the SSN delivery chain through peer-to-peer transfers, decentralized ledger access, and advanced programmability. These features would enable SSN agencies to have a reliable way of delivering funds to beneficiaries more independently from private financial institutions, automate payment delivery in ways that align closely to operational and design requirements of SSN programs, and directly monitor transfers through ledger access.

Nevertheless, using CBDCs for SSN delivery involves certain challenges, including the need for extensive customer due diligence, concerns over privacy protection, compliance risks, significant infrastructure and institutional capacity requirements, as well as risks of technological failure. The findings suggest that while CBDCs offer significant opportunities for enhancing SSN effectiveness, careful consideration of their implementation and integration with existing systems is essential, particularly in understanding the comparative advantages of CBDCs and their limitations against traditional methods of payment administration and delivery.

The paper targets social protection policymakers and finance specialists involved in CBDC development, emphasizing the need for collaboration and innovation to fully realize the benefits of CBDCs in the context of SSNs.

1. Introduction

The adoption of central bank digital currencies (CBDCs) as payment platforms has the potential to transform financial and payment service delivery, thereby enhancing governments' ability to provide social assistance benefits to the poor and vulnerable populations. In light of innovations in decentralized finance, central banks are increasingly exploring decentralized ledger technology to modernize their methods of delivering money to the public. As of 2024, 94 percent of central banks are engaged in CBDC-related initiatives, with about one-third piloting CBDCs. Notably, a few countries, including the Bahamas, Jamaica, and Nigeria, have rolled out live CBDCs (Di Iorio et al, 2024). This burgeoning interest suggests that CBDCs could emerge as a new option for payment delivery, including for social safety net payments.

This paper examines the design features of retail CBDCs[1], focusing on the benefits and risks they present for the implementation of social safety net (SSN)[2]. The impact of CBDCs on SSNs will depend on their design characteristics, which can vary widely in functionality. Nonetheless, it remains uncertain whether CBDCs will provide improvements over existing digital payment solutions and under what conditions they would enhance the effectiveness of SSNs. This report aims to take stock of recent developments in SSN-related CBDC design and implementation and address the following questions:

i. In what ways can CBDCs transform the delivery of SSNs, and which features of CBDCs would have the most meaningful impact?
ii. Do CBDCs offer advantages for SSN delivery that are not available through other payment solutions?

The key messages of the paper are the following:

- As *payment delivery solutions*, CBDCs are unlikely to yield substantial net benefits for SSN operations over existing payment solutions. While CBDCs can mitigate the risk of bank failure and facilitate instantaneous transaction settlements, similar outcomes can be achieved through effective traditional payment solutions. Deposit guarantees can address bank failure risks, and fast payment systems based on Application Programming Interface (API) integration and open banking can deliver nearly real-time settlements. Moreover, the anticipated improvements in financial inclusion associated with CBDCs are not definitively evident. While CBDC platforms may promote inclusion by bypassing dependence on bank accounts, reducing wallet creation and administration costs and thus making CBDC wallets more accessible and affordable than traditional bank or payment accounts for poorer individuals, conventional payment solutions, too, l have untapped potential for cost reductions. Furthermore, many CBDC implementations rely on traditional financial institutions' networks of clients and existing payment instruments (be it cards or mobile devices) and would therefore likely inherit the financial inclusion challenges associated with the latter.

[1] The terms "central bank digital currencies" and "CBDC" refers to retail CBDCs in the context of this paper. Wholesale CBDCs are outside the scope of this paper as they affect the process of settlement of accounts between financial institutions that are currently done using the RTGS of a central bank or cross-border settlements between financial systems in different jurisdictions. Consequently, wholesale CBDCs' implications on the way transfers from governments to individuals would likely be minor and would primarily manifest themselves in faster settlement times for the system of financial institutions as a whole.

[2] Social safety nets are programs and schemes that delivery social assistance, therefore, social safety nets and social assistance programs are used as synonyms.

- Conversely, CBDCs implemented as *payment administration solutions* can yield significant improvements throughout the SSN delivery chain. The most notable impacts are linked to blockchain technology, which supports peer-to-peer transfers, decentralized ledger access, and extensive programmability. These features would enable SSN agencies to automate complex conditional payments, execute transfers more autonomously with less dependence on payment services providers, and directly monitor transfers through ledger access.
- However, using CBDCs for SSN payment administration presents unique challenges, including high financial and administrative costs, extensive infrastructure requirements, and considerable risks, such as CBDC software or hardware failure, need for extensive customer due diligence, concerns over privacy protection, compliance risks, significant infrastructure and institutional capacity requirements, potential negative effects of excessive programmability on the role of CBDCs as a monetary anchor and low adoption rates.

- Given the unclear balance of costs and benefits, CBDCs may not offer dramatic advantages over the existing SSN delivery modalities, especially if traditional payment systems can effectively leverage programmability and decentralized access to transaction data. Indeed, some efficiency gains associated with CBDC deployment could be achieved through enhancements of traditional payment solutions, such as improving institutional environments (e.g., expanding national ID coverage and enhancing social registry capabilities), standardizing the financial sector through open finance, deepening API integration across traditional financial institutions, or combining blockchain solutions with conventional payment systems.

This paper targets two primary audiences: social protection policymakers and practitioners, as well as finance specialists involved in CBDC development. For the former, it outlines potential opportunities, risks, and tradeoffs of CBDCs as an SSN payment platform. For the latter, it offers insights into CBDCs from an SSN-related perspective, encouraging consideration of concerns and use cases that align with the needs of SSNs. The report is organized as follows: section 2 presents the analytical framework, section 3 reviews cases of implementations of various elements of the SSN delivery chain using CBDC platforms or blockchain, section 4 examines in detail the potential effects of CBDCs on each component of the SSN delivery chain and associated trade-offs, section 5 compares CBDCs to alternative SSN payment delivery solutions, and section 6 concludes.

2. Analytical framework

To examine the implications of CBDCs for SSNs, this paper builds on a simple analytical framework that integrates two components (1) a model of the SSN delivery chain and (2) a model representing a "typical" retail CBDC design scenario based on the review of CBDC literature.[3] The objective is to identify potential synergies between CBDC design features and SSN delivery chains, as well as to envision how a CBDC platform could improve SSN delivery. While other CBDC designs and SSN delivery modalities exist and can also be considered typical, this paper narrows its focus to a subset of designs that serves as a starting point for the analysis.

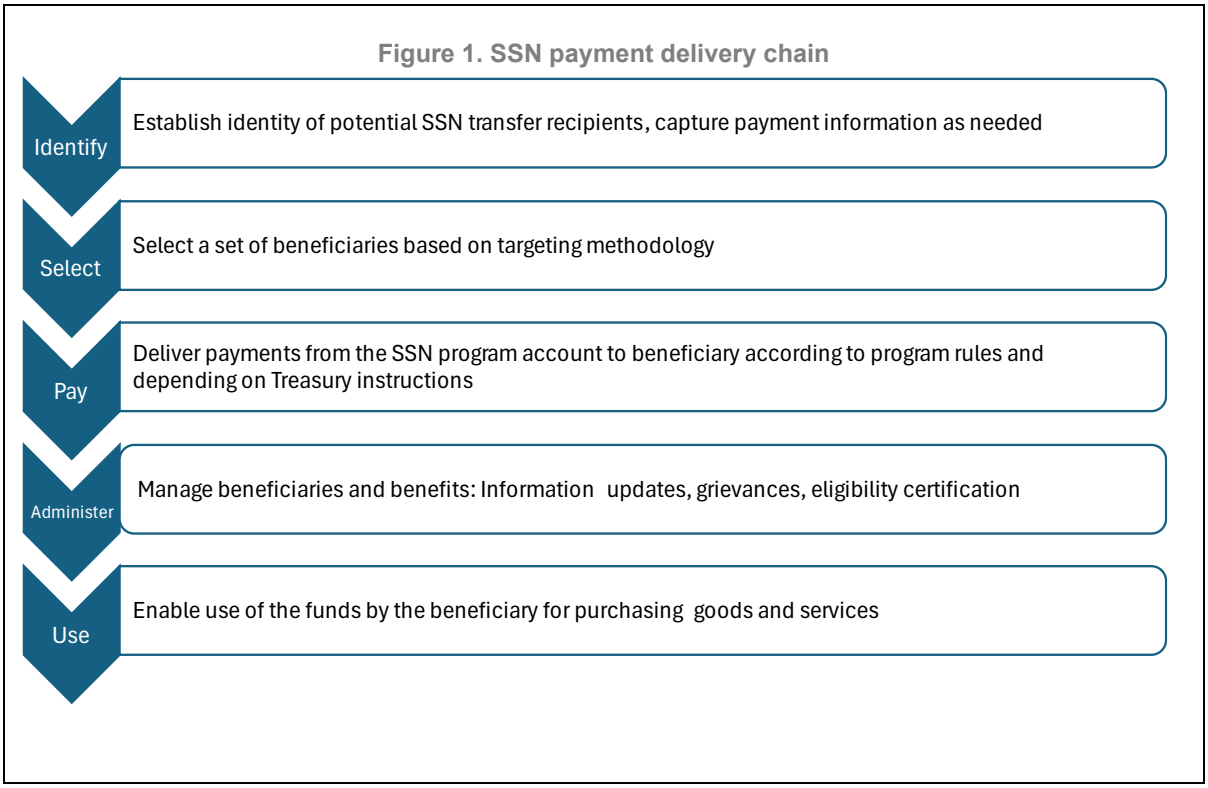
2.1 SSN benefit delivery chain

To deliver benefits to targeted social groups, SSNs deploy a structured delivery chain that ensures programs achieve the intended outcomes (e.g. poverty reduction, resilience to disasters or other shocks). As defined in this paper, the SSN delivery chain consists of 5 steps: identification; selection; payment delivery; payment administration; and use of benefits (Figure 1).[4]

1. Identification: unique units of assistance (individuals or households) are identified.
2. Selection: a subset of the potential beneficiaries is determined based on specific targeting criteria (e.g. poverty, nutrition status, disability, etc.).
3. Payment delivery: payments are made to the eligible beneficiaries.
4. Payment administration: payments are managed, updated and corrected as necessary.
5. Use of benefits: certain payment platforms have extended functionalities beyond benefit delivery, allowing funds to be utilized for purchasing goods and services. This aspect highlights the capability of CBDC platforms to support benefit administration and the effective use of benefits by recipients.

[3] The "typical" CBDC design that underpins this paper is a methodological construct aimed at structuring the discussion of CBDCs' impact on the delivery chain. The "typical" retail CBDC is a combination of design features that have emerged as a sufficiently common design scenario, and analyzing these features can yield valuable insights. It is important to note that this approach does not preclude the possibility that other design settings could be considered typical, feasible or desirable. Methodologically speaking, the "typical" CBDC design scenario plays the heuristic role, similar to that of Weberian ideal types (See Kim, 2024).

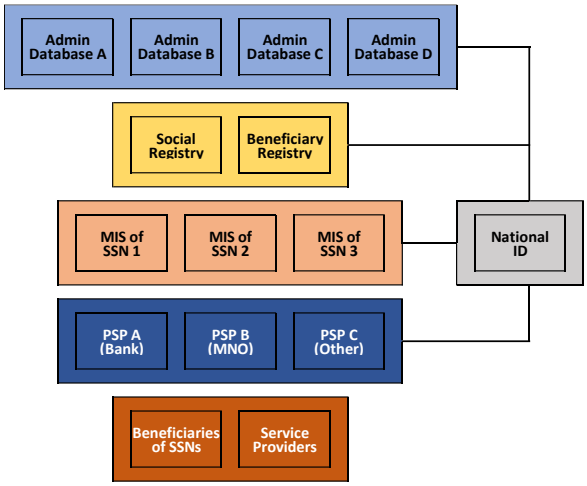
[4] This framework is adapted from the standard SSN delivery chain based on operational processes (see World Bank, 2020). It is important to note that the conventional depiction of the delivery chain has two limitations: (1) it stops at payment delivery, and (2) it does not clarify the relevance of the different business processes to the payment delivery.



SSN management information systems (MIS) are essential for effectively managing the delivery of program benefits. These systems are a crucial part of each element of the delivery chain illustrated in Figure 1: they oversee data related to beneficiaries and benefits (encompassing tasks such as collecting data on applicants, confirming their identify, selecting beneficiaries, calculating benefit amounts, and maintaining up-to-date beneficiary records). However, SSN MIS often depend on other interoperable systems for specific functions: for instance, they rely on payment service providers (PSPs) to execute payments based on instructions from the SSN MIS[5]. Additionally, SSN MIS utilize various government databases (such as tax authority data, cadastral records, business administration records, civil registries, and social registries) to collect relevant information for assessing the welfare of potential beneficiaries. Together, the SSN MIS and all the interconnected MISs of other agencies form comprehensive SSN ecosystems. National identification IDs are central to SSN ecosystems as they facilitate interoperability among the various linked databases. The complexity of SSN ecosystems and their degree of interoperability vary considerably across countries, largely depending on the coverage and effectiveness of the national ID system.

[5] Payment instructions usually involve passing information to PSP systems about the timing of SSN benefit payment, payment information of the beneficiaries, and the amount of the transfer.

Figure 2. SSN ecosystem comprising SSN MISs, national ID database, other agency databases, payment service providers, beneficiaries, and service providers



Source: Authors' representation.

The complexity of SSN ecosystems, characterized by multiple specialized sub-systems such as PSPs, government departments, and social registries, creates significant coordination challenges. This complexity leads to issues such as imperfect information flows, a lack of transparency and control, and transaction costs. However, CBDC platforms have the potential to address these challenges, offering solutions that can streamline operations and improve overall efficiency of SSN ecosystems.

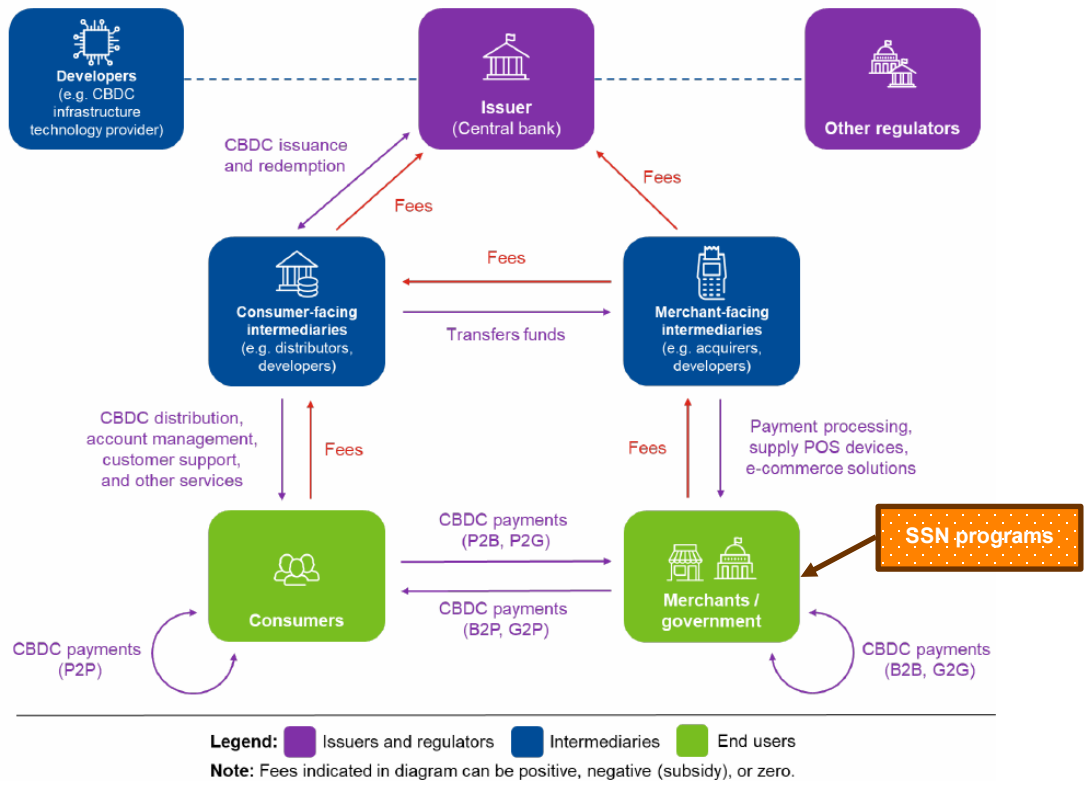
2.2 Key CBDC design features

Retail CBDCs are digital central bank money held by individuals and businesses in CBDC wallets and used to make payments on a CBDC platform. According to established practices, CBDCs refer either to (a) the digital currency issued by the central bank – more precisely CBDC tokens[6] – or (b) the platform that facilitates transactions using these tokens.

From a technical perspective, a CBDC platform, as defined in this paper, is a network of participants with different functions and capacities. The central bank issues (or "mints") digital money and makes it available through intermediaries to the general public, including individuals, businesses, and government institutions, for transactional purposes (see Figure 3). Participants transact with each other through CBDC wallets, which function similar to deposit accounts. These wallets store CBDC funds, execute transactions on the network and have unique addresses. Developers and regulators enable the functioning of the platform and establish rules for participants, including wallet size limits, allowable transactions, and customer due diligence (CDD) requirements. The software that operates the CBDC platform allows each wallet to interact with others through "smart contracts" – pieces of code containing instructions for transferring balances from one wallet to another). Transactions between the wallets are recorded in a ledger.

[6] A CBDC can be issued in the form of balances on accounts or digital equivalent to cash, i.e. tokens. In this paper we assume that the CBDC has the form of tokens.

Figure 3. Stakeholders in the CBDC Ecosystem



Source: Koonprasert et al. (2024).

The current trend in live retail CBDCs (especially in Emerging Market and Developing Economies) is to implement CBDC platforms using blockchain technology, although non-blockchain implementations are also possible. The reliance on blockchain is a legacy approach inherited from decentralized finance. Other solutions that deliver programmability, data security, and integrity of transaction records do not inherently require blockchain. In fact, centralized ledgers could offer advantages in transaction settlement speed by bypassing the need for trustless settlement design. However, due to the prevalence of blockchain-based CBDC implementations, it is reasonable to treat blockchain technology as a default solution for the purpose of this paper. Furthermore, certain elements of blockchains, such as transparency of the ledger (whether it is visible to the public or only to a limited set of "authorized" participants in the CBDC network) could have implications for payment reconciliation and monitoring, as discussed below.

A CBDC platform can be thought of as a distinct payment rail or system that operates parallel to other payment rails, such as bank deposit rails (network of deposit accounts operated by banks) and card rails (network of credit and debit cards operated by credit card companies). Many retail CBDC design configurations are possible, each defining the characteristics of CBDC (e.g. account-based or token-based), features of the wallets, rules governing transaction, roles of network participants, etc. In practice, central banks have been converging toward a narrower set of CBDC designs options, to which we refer as a "typical" retail CBDC. A "typical" CBDC design is characterized by the following features:

1. It represents a liability of the central bank and is free from the risk of default. In terms of transactions on CBDC platforms, this means that CBDC balances are actual stocks of tokens issued by the central bank. This distinction is significant compared to private money in deposits, which are obligations of private banks that may not be fully backed by available liquidity. Consequently, from a non-technological perspective, transfers between CBDC wallets are transactions in funds that are, by definition, readily available. Transactions with CBDCs can be executed immediately without any additional steps to ensure fund availability; consequently, CBDCs would be free from the risk of private bank default. However, the value of CBDC tokens can still be affected by government default and devaluation of the currency, including its digital form.
2. It would be non-interest bearing so that storing funds in CBDC forms does not accrue interest. CBDC designs that have been piloted at scale or fully rolled out treat CBDC tokens as digital equivalents of physical cash, which does not inherently bear interest. By defining CBDC wallets and CBDC tokens as non-interest bearing, central banks can mitigate the risk of disintermediation of private banks, where deposit account holders may move their funds to CBDC wallets if the latter were to bear interest.[7]
3. The design would impose limits on wallet balances and CBDC holdings, specifying the maximum value that can be stored. In the absence of interest rates, CBDCs may introduce monetary policy transmission risks (Das et al., 2023). CBDC wallet size limits could be used to exercise monetary policy controls over the flow of funds between CBDC wallets and deposit accounts, especially in times of limited confidence in the private financial institutions or during periods of negative interest rates. Over two-thirds of central banks advocate setting CBDC holding limits, however there is significantly less consensus on placing transaction limits and embedding capital flow management measures (Di Iorio et al, 2024).
4. It would be implemented via a two-tier intermediated architecture that relies on traditional financial institutions (FIs), such as banks, whose role could be to distribute CBDCs and/or to operate part of the CBDC network. To avoid disintermediation of existing FIs and to leverage their existing capacities, existing FIs would function as a tier between the central bank and the retail clients. Authorized FIs would receive licenses to distribute new denominations of CBDC tokens when transactions occur and change s necessary, maintain and operate CBDC wallets, and facilitate transactions on a decentralized ledger.[8] The central banks would retain their traditional role of currency issuers and fiscal regulators, while financial institutions would manage retail clients and operations, including client development, onboarding, CDD, payment instruments issuance, and network maintenance.
5. The “typical” CBDC design envisions that wallet creation would involve full or partial CDD that complies with counter-financing terrorism (CFT) and anti-money laundering (AML) regulations. Full CDD comparable to the standards of the banking sector means that creating a wallet requires a national ID and each wallet and transaction can be linked to a specific individual or entity.[9] Full CDD would be mandatory for nearly[10] unrestricted use of retail wallets similar to deposit accounts. However,

[7] In the case of negative interest rates even a non-interest-bearing CBDC wallet would be more attractive than a bank account, which creates a risk of disintermediation. In this case, regulatory controls would likely be required to prevent outflow of funds from deposit accounts toward CBDC ones.

[8] When distributing CBDC, it could also be possible for intermediaries to mint new denominations of CBDC tokens under their CBDC license. Banks would act on central bank’s behalf and the funds they distribute and mint will not be private money but central bank money. FIs and banks are not able to increase the value of CBDC in circulation since this is the core task of the central bank. The minting therefore only encompasses the creation of new denominations of tokens when payments are made, e.g. a 100 token is split in two new tokens (80 and 20 when a 20 payment is done).

[9] This could be considered, from a theoretical perspective, an account based model because the wallet is connected to a specific identified physical person as the holder of a wallet, just like a bank account.

[10] Some restrictions related to AML/CFT regulations would still apply.

in some cases, relaxed CDD are proposed to enable restricted use, such as smaller transactions sizes and limits on balances).[11]

6. Online CBDC transactions would be pseudonymous and private, but not fully anonymous. Given the importance of CDD, neither wallet-to-wallet transfers nor token transactions would be fully anonymous. Nonetheless, a high degree of privacy protection would be afforded by limiting access to transaction details to a select number of authorized parties and implementing privacy protection protocols.[12]
7. It would likely use the distributed ledger technology (DLT) implemented over permissioned networks rather than fully permissionless public networks. It is important that CBDC solutions generate trustworthy ledgers that support validation of transactions by trusted validators and are accessible to independent and impartial auditors to ensure their transparency and integrity. Transaction validation would be done by a group of authorized financial institutions with appropriate licenses that allow access to the transaction ledger for validation purposes (e.g. validators and designated "auditors"). The choice of permissioned (rather than permissionless) networks is driven by the need to comply with bank secrecy and data protection requirements, which fully public ledgers do not provide. Additionally, the consensus mechanism of permissionless networks, prior to the settlement of CBDC transactions, is not suitable for a CBDC system operated by a government authority since a temporary majority could take control of the network. While there is no unanimity on the use of DLT, the trend among central banks in emerging economies is to lean toward using DLT over permissioned networks (Di Iorio et al., 2024).
8. CBDC platforms can support a wide range of programmable applications, or smart contracts, which could dramatically improve the efficiency of payment delivery, administration, and use of funds through automation. Current CBDC platform designs recognize the benefits of programmability of CBDC transactions. While the potential scope of programmability is extensive, depending on how effectively CBDC platforms can leverage external data and execute internal functions (Lavayssiere and Zhang, 2024), most CBDC designs have implemented a limited subset of programmable functions. These functions may include (a) timed transfers, (b) restrictions on wallet size or control over funds, (c) restriction on the type of products and services that can be purchased, and (d) automatic transfers of funds from CBDC wallets if a certain set of conditions apply (e.g. if funds were deposited into a CBDC wallet with the condition that they are used within a year are not in fact used and are refunded to the depositor). More advanced programmable functionality related to the use of tokenized assets has been tested as proofs-of-concept. While such functionality presents implementation challenges, it holds significant promise for streamlining payment delivery, administration, and fund utilization. Nevertheless, even relatively simple programmable functionality involves infrastructure, institutional capacity, and regulatory frameworks that are yet to be developed, along with risks that remain difficult to assess and manage.

[11] Token-based transactions might still be supported but in a way that complies with AML/CFT. Funds in CBDC wallets can be stored in the form of tokens, which could function as bearer instruments, at the time of minting they could be linked to a particular wallet or deposit account. For instance, at the time of creating tokens, IDs are created, which could link each token with a given wallet and therefore a unique individual or legal entity. This would be equivalent to taking cash out of your deposit account but writing a note in the ledger that includes bank note ID numbers.

[12] The European Central Bank is considering anonymity for offline CBDC payments. However funding and defunding of the offline wallet will be traceable.

2.3 Mapping of CBDC design features onto the SSN delivery chain

Typical CBDC design features could impact different processes of the SSN delivery chain, (Table 1). This material will serve as the basis for the detailed discussion of the implications of CBDCs for SSN delivery in section 4.

Table 1. Implication of CBDC features for the SSN delivery chain

CBDC feature	*SSN delivery chain processes*				
	Identify	*Select*	*Pay*	*Administer*	*Use*
CB liability	Not relevant	Not relevant	All funds actually available in wallet Instant payment	Instant assurance of balance on wallets	No risk of failed / returned payments
Non-interest bearing	Not relevant	Not relevant	Not relevant	Not relevant	If negative interest rates, funds from deposit account may be transferred to CBDC wallets
Policy-motivated restrictions on wallet size	Not relevant	Not relevant	Some transfers may be returned due to wallet size restrictions	May require additional arrangements to manage over-the-limit transfers	Use may be complicated by limit management arrangements
Intermediated	Intermediaries may be involved in onboarding users and conducting customer due diligence.	Not relevant	Potential for multiple ways of distributing payment execution roles between FIs and SSN agencies with greater autonomy of the latter	Potential for multiple ways of distributing payment reporting and reconciliation roles between FIs and SSN agencies	Not relevant
ID linked wallet	If required, customer due diligence measures may facilitate identification of payees.	Enables and promotes interoperability with other administrative databases using national ID	Permanent/ immutable CBDC wallets linked to national ID can enable people to receive payments at any time	ID-linked CBDC wallets would support interoperability with other administrative databases, can support tokenization	ID-linked CBDCs may better support programmed wallet functions

Pseudonymous	Not relevant	Not relevant	More secure payment since less personal data exchange in transactions	Not relevant	Not relevant
Permissioned DLT	Not relevant	Not relevant	Not relevant	SSN administrators' access to the ledger could support analytics, monitoring and evaluation (M&E), fraud detection, tracking the use of benefits	Not relevant
Programmable	Not relevant	Not relevant	Automatic execution payment delivery, reconciliation through smart contracts	Automation of M&E, reporting, grievance redress through smart contracts	Conditioning beneficiary spending through programming wallet functions

3. Cases studies of CBDC and blockchain implementation experiences relevant to SSNs

This section examines CBDC implementation experiences where elements of the SSN delivery chain have been facilitated either through CBDC platforms, or with the help of blockchain technology. CBDC pilots and full-scale implementations have focused on use cases related to the ability of CBDC platforms to execute core functions, such as accurately executing payments and ensuring the correct delivery of services or products in exchange for payment. Nevertheless, there are a small number of documented cases that are relevant to the SSN context and illustrate the potential of CBDCs to improve the delivery of SSNs (Table 2).

Table 2. Aspects of the SSN delivery chain addressed by case studies

Case study	*SSN delivery chain processes*				
	Identify	*Select*	*Pay*	*Administer*	*Use*[13]
Disability insurance (Australia)	No	No	Yes	Yes	Yes
Conditional payments for a school feeding program (Kazakhstan)	No	No	Yes	Yes	No
Crop tokenization (Brazil)	Yes	No	Yes	Yes	No
Automation of administration of subsidized loans (Brazil)	Yes	No	Yes	Yes	Yes
Incentivizing CBDC adoption through tiered wallet CDD (Nigeria)	Yes	No	Yes	No	No

3.1 Disability assistance on blockchain (Australia)

Australia's National Disability Insurance Agency (NDIA) experimented with using blockchain technology to implement the entire delivery chain for the provision of client-specific disability insurance payments, aiming to achieve efficiency gains.[14] NDIA provided funds for disability support services that are required in accordance with the rules set for each beneficiary. Since beneficiary profiles and their needs vary considerably, so, too, vary their spending rules. Eligible beneficiaries may face significant transaction costs related to complex budget management tasks, booking services, and making payments; service providers face transaction costs and risks related to ensuring that the services provided are eligible for NDIA compensation.

To facilitate these conditional transfers, a programmed money solution based on a blockchain was adopted. The program tokenized funds held in traditional deposit accounts and attached smart contracts that defined the conditions under which tokenized funds could be spent, including timing, amount, and eligible expenses, which were beneficiary specific. Beneficiaries could access their accounts via a mobile app to book services aligned

[14] Although this case study does not involve the use of CBDCs, it exemplifies two key aspects: (a) the rich and complex programmability of transactions that can potentially be achieved on fully functional CBDC platforms, and (b) the seamless integration of payments with operational SSN MIS on a single platform. It is important to note that while this case demonstrates advanced programmability through a blockchain solution, other non-blockchain solutions could similarly achieve the same outcomes, provided they enable comparable functionality.

with their profiles and service plans. Upon delivery of eligible services, providers received blockchain tokens, which they then transferred to the NDIA to request payment, which would occur within seconds. The data on services booked by the participants and delivered by the service providers could be viewed in real time and could support budget planning, analytics, oversight, and quality control. Notably, payment processing occurred through national payment systems and did not require CBDCs, given Australia's well-functioning and highly interoperable banking system. Performance assessment results indicate that the National Disability Insurance Scheme (NDIS) empowered beneficiaries, provided greater certainty for businesses regarding services eligibility for payment), and enhanced transparency and controls over the fund utilization for the NDIA. Furthermore, testing showed considerable economic benefits, saving NDIA and its clients between 1 and 15 hours per week, while service providers reported potential yearly cost savings of 0.3 percent to 0.8 percent (Royal et al., 2018).

Key takeaways:

- Blockchain technology stack can be used for efficient management of conditional benefit payments.
- Significant efficiency gains can be realized for both the beneficiary and service provider through automation of complex conditionalities.
- Automation of conditionalities can be especially useful for implementing benefits that are highly individualized (such as individualized treatment plans based on specific disability profiles).
- With appropriate user experience (UX) design, some of the benefit administration tasks can be transferred to beneficiaries.

3.2 Conditional Government-to-Person (G2P) payments for a school feeding program (Kazakhstan)

As part of its CBDC pilot, the National Bank of Kazakhstan piloted a use case of automated delivery of payments for subsidized school lunches to the participating cafeteria. The Almaty school district operates a school feeding program that provides subsidized meals ("social lunches") to school students. Under this program, students swiped their meal cards at dedicated terminals, with each swipe corresponding to one meal received. Once the card is swiped, the terminal communicates to the participating bank that a meal transaction has been validated. Based on the validated transactions, the bank initiates a transaction on the Digital Tenge[15] platform to transfer a given amount of CBDC that corresponds to the value of a school lunch from the school's bank or payment account to the cafeteria account.

Payment transactions were carried out over the CBDC platform but used the existing payment infrastructure of the national payment system. To facilitate these payments, both the school and the cafeteria used the funds in their traditional bank or payment accounts. When the payment is processed, the school's bank converts deposit funds to Digital Tenge, and the cafeteria's bank converts the Digital Tenge back into deposit funds. This transaction did not require setting up CBDC wallets for individual students or their parents (National Bank of Kazakhstan and National Payment Corporation of Kazakhstan, 2023).

Key takeaways:

[15] Digital Tenge is the digital currency issued by the Central Bank of Kazakhstan.

- CBDC technology can serve as a layer to administer automated transfers between conventional deposit accounts. A similar solution could be employed to facilitate payments via mobile network operators (MNOs).
- Payments can be triggered by a verified information of benefit delivery. What counts as reliable information for the purposes of SSNs can be defined by the SSN agency. If the agency considers the number of card swipes recorded in the SSN MIS or by a trusted party to be reliable evidence of service delivery, these data can be used as a trigger to initiate transfers.

3.3. Tokenization to improve farmers' access to credit (Brazil)

One of the challenges faced by CBDC platforms and other blockchain systems is to execute transactions in response to real-life events (for instance, transferring funds from one contracting party to another upon the delivery of goods or services that are non-digital in nature and that require digital representation). Tokenization is the process of creating such a representation. In the context of SSNs, tokenization can facilitate the implementation of programs that involve the transfer of funds when a verifiable real-life event occurs.

The Central Bank of Brazil has selected for further piloting two proof-of-concept[16] use cases that involve tokenization of real-life assets: (a) the use of smart contracts using the DREX platform to enable access to finance for small to medium-sized farmers against their tokenized crops and (b) improved administration of subsidized loans to small and medium sized agricultural producers. Both use cases are directly applicable to the SSN context since providing access to credit (whether through subsidized government funds or commercial credit) is commonly used by SSNs as a compliment to cash transfers or as a graduation strategy for households who are no longer eligible for SSN benefits but still require alternative sources of livelihood. It is important to note that neither of these two proofs-of-concept has been piloted yet.

- *Crop tokenization:* Brazilian farmers regularly experience difficulties in accessing credit in a market structure with limited sources of credit from a handful of agricultural conglomerates. To address this problem, Visa Brazil proposed a blockchain solution using the DREX platform for the use case of a soybean family farmer looking to finance his harvest by selling an existing crop sales contract to a third party at a discount. This solution leverages the national instant payment system (PIX) and allows for offline payments to employees (useful for payments at work sites without internet connectivity). The proposed user journey on the blockchain includes: (a) the farmer creating a DREX wallet through his commercial banking app after completing an automated identification and verification procedure, and funding it with fiat money from a checking account; (b) validating and tokenizing his real-world sales contract by minting a non-fungible token (NFT); (c) auctioning the NFT through a Digital Asset Marketplace using an auction-creation smart contract; (d) settling the sale of the NFT through a delivery-versus-payment smart contract; and (e) enabling the farmer to pay his workers using the funds received from the sale of his tokenized sales contract, either online through account transfer via PIX or through an off-line modality (Howard and Smith, 2023). [17]

[16] The Central Bank of Brazil has made available to the developer community a test environment of its digital real platform, known as DREX, for the purpose of prototyping applications using the DREX that can serve as proofs-of-concept.

[17] In another version of conditional payments, in April 2024, India's IndusInd Bank executed payments to farmers for carbon credits with a programmable e-rupee. The private lender created digital wallet for a pilot cohort of 50 farmers in Maharashtra state and administered their CBDC payments.

- *Automation of administration of subsidized loans:* Another proposed pilot currently at the proof-of-concept stage, involves deploying smart contracts on the DREX platform to streamline the implementation of subsidized loans to small and medium sized agricultural producers. This initiative aims to automate the conditional spending of the subsidized loan funds on approved types of expenses (agricultural inputs) from an approved list of suppliers (Orestes and Townsend, 2023).[18] The traditional loan implementation process is often hindered by administrative bottlenecks since the applicant farmers must submit an agronomist-approved loan proposal, purchase agricultural insurance coverage, and provide extensive evidence that the loaned funds were used exclusively for paying qualifying operational costs. Due to these high administrative costs, only a handful of private banks were willing to handle such loans, limiting the effectiveness of the scheme. This proof-of-concept envisions using the CBDC platform to automate the entire delivery chain for processing and administering these subsidized loans in the test environment. Sets of smart contracts would manage the loan application process with the banks, execute rule-compliant payments to suppliers, and settle the loans.[19]

Key takeaways:

- Tokenization is technically challenging but achievable. It can produce significant efficiency gains for loan processing and for the verification of eligible expenses.
- Effective and scalable tokenization solutions would be needed to support high volumes of tokenized transactions.

3.4 Attempts to incentivize Nigeria's CBDC adoption through tiered wallet CDD (Nigeria)

Nigeria was the second nation – after the Bahamas – to implement CBDCs on a national scale but has struggled with CBDC adoption. Following a strong initial uptake driven by novelty, new wallet creation plateaued, reaching less than 1 percent of bank accounts, while merchant wallet downloads accounted for about 10 percent of merchants with point-of-sale terminals. Most of the wallets (92 percent) appeared inactive since the initial launch (Wezel and Ree, 2023).

To stimulate CBDC platform onboarding, the Central Bank of Nigeria introduced multiple tiers of wallets. These tiers featured larger wallet sizes and higher limit on the size of transfers reserved for persons who provide more CDD data (see Table 3). This initiative aimed to address the limitations presented by the lack of CDD compliance for onboarding clients onto the e-Naira CBDC platform.[20]

[18]These subsidized loans are extended by Brazil's National Program for the Development of Family Farming (Pronaf).

[19] Specifically, the platform can (a) match farmers with multiple banks through an auction process whereby the farmers would submit their proposal to the banks and the banks bid on the approved loan proposals in a smart contract-executed auction; (b) issue tokens for the value of the loan; (c) execute payments to suppliers after automatically verifying compliance with the credit line's rules, completing CDD for farmers and suppliers, and ensuring appropriate spending of funds (sale invoices for operational expenses were uploaded and verified by the system before the transmitting to the supplier the value of the token equivalent to the cost of purchased inputs). To facilitate the verification process, a whitelist of pre-approved suppliers would be generated.

[20] The Bahamas CBDC platform, Sand Dollar, also adopted a tiered system that followed a similar logic (Branch et al, 2023).

Table 3. Identification requirements and limits (in naira) for different tiers of CBDC wallets

Tier	Requirement	Wallet limit	Transaction limit	Withdrawal limit
0	Phone number	120,000	20,000	500
1	National ID number	300,000	50,000	50,000
2	Bank verification number	500,000	200,000	200,000
3	Bank verification number + utility bill	5,000,000	1,000,000	1,000,000

Source: Central Bank of Nigeria (2024).
Note: In 2024, the average exchange rate for Nigerian naira was NGN 1,465.04=USD 1, but the naira experienced significant depreciation relative to the US dollar throughout 2024 from NGN 899.10 on January 1, 2024 to NGN 1524.20 on December 31, 2024.

Despite the introduction of low minimum CDD requirements on CBDC wallets, CBDC wallet adoption remained slow, indicating that relaxing CDD compliance was insufficient to attract users. Furthermore, while compliance with higher CDD standards was associated to significant increases in wallet size and transaction limits, very few users who onboarded at the minimum CDD tier upgraded to a higher CDD tier. As of May 2023, 97 percent of wallets were classified as Tier 0, suggesting that while the low CDD standard may facilitate onboarding, the tiered limit structure does not provide sufficient incentives for holders of e-Naira wallets to transition to higher tiers with higher CDD standards (Ledger Insights, 2023).

One of the barriers to CBDC wallet adoption in Nigeria has been the lack of national IDs, undermining financial institutions' ability to conduct even basic CDD and contributing to financial exclusion. As of September 2022, Nigeria's National Identity Management Commission had issued 90 million national identification numbers (NIN) for a population of over 220 million, with the number of NINs expected to reach 148 million by end of 2024.

Key takeaways:

- Relaxing CDD requirements alone is insufficient for the successful adoption of CBDC.
- The lack of national IDs undermines CBDC adoption.

4. Effect of CBDC platforms on the SSN delivery chain

This section presents a detailed discussion of the implications of specific CBDC design features for the SSN delivery chain. It builds on the linkages already established between the SSN delivery chain and typical CBDC design features in the analytical approach section, as well as implementation experiences documented in the case studies.

4.1 Implications for the identification of beneficiaries

Effective CBDC platforms that are built around ID-linked wallets and stringent CDD requirements can generate demand for more robust and comprehensive national identification systems. This, in turn, would improve interoperability for the entire SSN delivery ecosystem, enhance automation of the SSN business process and promote coordination of entities involved in SSN provision. National IDs are central to effective implementation of SSN programs as they allow different administrative databases, registries, MISs or specific SSN programs, and payment service providers to exchange data on concrete individuals, families, and households (see Figure 2). A well-performing CBDC platform that demonstrates its value to clients would motivate people to obtain national IDs if these are required to access the CBDC platform. Over time, increased coverage of the ID system would translate into improved interoperability of social registries and other administrative databases and would automate the collection and updates of social registry data. For this effect to occur, CBDCs would need to require national IDs; conversely, in cases when CBDC wallet creation does not require national ID data (as in the case of low-tier wallets on the e-Naira platform) CBDCs will not generate additional incentives to obtain IDs. Further, the perceived value of having a full-fledged CBDC wallet would need to be sufficiently high to stimulate ID adoption.[21] In the short term, however, linking CBDC wallets to national IDs may present a barrier to CBDC adoption. The opportunity cost of requiring ID linkages for CBDC accounts is modest, given that the value added of CBDC wallet with weak CDD standards is likely to be limited, and their role can be played by other conventional solutions (such as MNOs).

The prospect of receiving SSN transfers into CBDC wallets may provide additional incentives for poorer individuals to obtain national IDs which may facilitate CDD. Poorer individuals may not respond to the incentive of accessing higher wallet and transfer size limits because low wallet and transfer limits may be sufficient for their everyday payment needs. However, the prospect of receiving larger, recurrent transfers paid by SSN programs may encourage them to obtain a national ID, which may facilitate CDD. Other incentives to offset the financial (ID issuance fees) and opportunity costs (time spent collecting supporting documents and travelling to ID-issuing facilities) of obtaining a national ID would be advisable.

SSN systems supported by national IDs would be better positioned to benefit from CBDCs for several reasons:

[21] On the e-Naira platform, the only tangible benefits that provide an incentive to obtain a higher-tier full CDD account linked to a national ID are increased account and transaction size. The low rate of conversion of lower-tier to higher-tier e-Naira accounts suggests that these benefits are insufficient, especially when considered against risk. If CBDCs were to expand adoption of national ID-linked accounts among the poorest households, higher wallet and transaction limits may not be relevant for the very poor whose transactions are usually small.

- National IDs would enable interoperability between CBDCs, SSN ecosystem, traditional finance and any innovative financial instruments based on decentralized finance (defi) infrastructure. The automation capacity of CBDCs puts an even higher premium on national IDs than current SSN delivery chains imply. National IDs would serve as a bridge between CBDCs, SSN ecosystem, traditional finance or any defi instruments that may evolve overtime, as well as other smart contracts that might become executable on CBDCs.
- A national ID system enhances the potential impact of CBDCs on financial inclusion. Given the importance of CDD compliance for CBDCs, improvements to the national ID system would have a significant effect on CBDCs' financial inclusion, especially regarding inclusion in non-payment-related financial services, which rely on traditional finance or defi instruments. Additionally, investment in national ID systems would produce gains in financial inclusion even if the CBDCs platform fails, by enabling financial inclusion through traditional payment delivery mechanisms.
- National IDs would improve the functionality of both CBDCs and SSNs. In addition to eliminating CDD barriers to the registration of fully functional CBDC wallets, expansion of the national ID coverage would enhance the functionality of the SSN delivery chain as well as the CBDC platform.[22] Conversely, if the national ID system is not established or excludes a certain proportion of the population, CBDCs' potentially transformative impact on SSNs would be limited.
- Biometric IDs used over the blockchain would be an especially powerful tool to drive automation of SSN delivery over CBDC platforms. For instance, biometric IDs could facilitate the automation of verifying compliance with conditionalities by the correct beneficiary. However, the use and storage of biometric data on CBDC platforms may raise additional questions about data protection and privacy.

4.2 Implications for beneficiary selection and welfare assessment

Allowing a degree of access to the CBDC transaction ledger to parties outside of the immediate payment service provider and the central bank can have major implications for beneficiary selection and welfare assessment. CBDC platforms would store transactions – payments made to and from CBDC wallets – on ledgers, and SSN agencies could potentially access this information for welfare assessment and eligibility decisions. For instance, if the total income received by an existing beneficiary on CBDC wallets exceeds (or falls below) a certain eligibility threshold, the recipient could potentially lose (or gain) eligibility for SSN benefits. Expenditure data (value of outgoing payment transactions from the CBDC wallet) could also be factored into the eligibility decision so that expenditures on costly or luxury items could disqualify individuals from receiving benefits.

The utility of CBDC ledgers for welfare assessment would depend on the level of adoption of the CBDC platform, not only in terms of the absolute number of wallet holders, but also its share in the total value of incoming or outgoing transactions by the population using their CBDC wallets as opposed to other platforms. Welfare estimates based on CBDC transfers would lack accuracy if the CBDC platform represents a small fraction of incomes or expenditure. Thus, the utility of CBDC legers for welfare assessment would likely be limited until they are capable of reflecting a sufficiently large share of incomes or expenditures for individuals who predominantly use CBDC wallets for their transactions.[23] Alternatively, a CBDC ledger could be used in conjunction with income and consumption data from other payment platforms (i.e., main banks and other

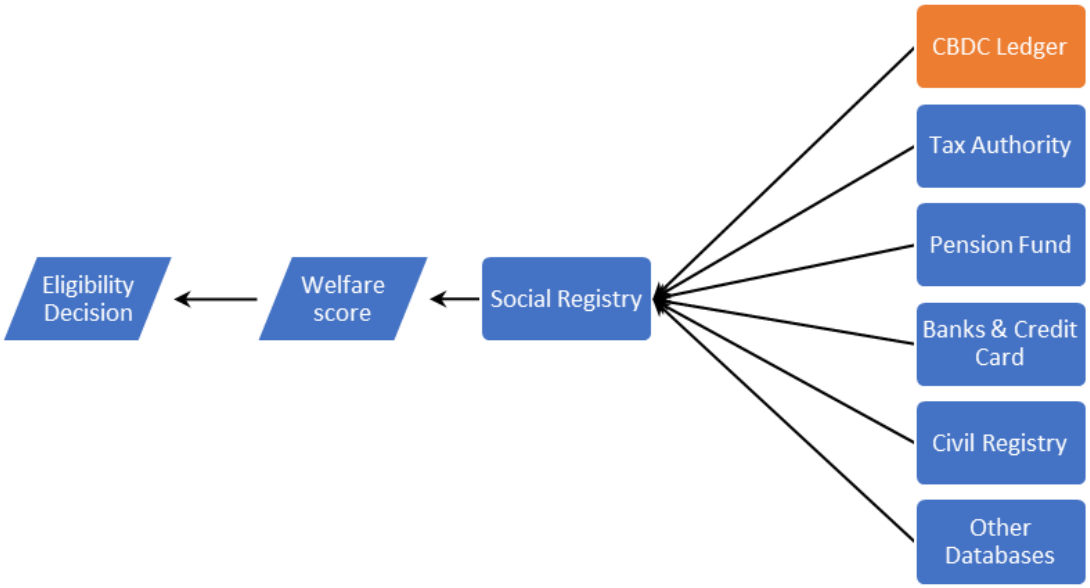
[22] National ID systems have positive effects across a wide range of digitization efforts (Bird and Hanedar, 2023).

[23] Because payment receipts are easier to keep account of (as there are fewer of them than expenditures) the discussion focuses on incomes.

payment service providers), in which case, CBDC programmability could facilitate interoperability of these platforms and automate the computation of a cross-platform welfare aggregate.

This use of the CBDC ledger for welfare estimation could potentially complement social registries. Since social registries that are interoperable with administrative databases that can pull together data on incomes or expenditures of households, CBDC ledger data could act as one of such inputs alongside taxation records, pension fund data, or records of major banks or credit card companies if there is adequate regulatory basis for the sharing of private data with SSN administrators (see Figure 4).

Figure 4. CBDC Ledger Providing Inputs into the Social Registry to Support Welfare Estimation and Eligibility Determination



Source: Authors' presentation.

However, the use of CBDC platforms for targeting may discourage CBDC adoption if the public perceives CBDC wallets as a means of excluding them from social assistance, to which they may be eligible, or exercising excessive state surveillance and accessing sensitive private information. This perception could incentivize the public to transact using non-electronic instruments or use other electronic payment platforms that better protect recipients' data, which in turn could make spending more difficult to observe, particularly in contexts where trust in government is low. Nonetheless, the experience of other digital payment applications suggests that concerns around data privacy are not absolute and heavily influenced by communication and the perceived value of suspending certain privacy restrictions. If the public experiences tangible benefits from the CBDC platform, the visibility of CBDC wallet balances and transaction to SSN administrators may not be a critical concern. Furthermore, transparency about the use of CBDC ledger data, effective communication regarding the fairness and effectiveness of the targeting practices that use CBDC wallet data, and robust and well-publicized privacy protection measures would go a long way to build acceptance of the use of CBDC data for targeting, ultimately fostering public trust in government.

The use of CBDC ledgers to analyze transactions related to SSN transfers and beneficiaries can be a potential use case that future SSN-minded pilots could explore. As of the time of writing of this paper, the review of SSN-related CBDC implementations did not identify any cases of active use of transaction ledgers for the purpose of operational use, such as welfare assessment, auditing of transaction, or other operational analytics.

4.3 Payment delivery

This section considers the implications of specific CBDC features on the delivery of SSN payments:

- Direct government control over the CBDC platform, allowing for greater control over CBDC wallets and transactions compared to accounts held at private financial institutions.
- The ability of CBDC wallet holders – including SSN administrators with the authority to execute SSN payments – to execute peer-to-peer transactions with significant autonomy from financial institutions.
- Wallet size limits.
- Access to the CBDC ledger by numerous parties outside of financial institutions.

CBDC platforms can be used by governments to establish unique permanent CBDC wallets[24] for every citizen, including those for whom private banks and financial institutions are unwilling or unable to provide accounts. This would ensure that every citizen has access to a government-provided payment account capable of receiving and sending payments, including government transfers. Following the same logic, the government of Sweden established tax payment accounts for all its citizens on a traditional payment platform, thus creating a default fail-safe means for its citizens to receive tax refunds and to pay their excess taxes. A permanent CBDC wallet would extend the utility of the tax payment accounts beyond just receiving tax refunds to encompass a variety of government payments, including those related to SSNs.

Permanent CBDC wallets would simplify logistics around payment data collection and significantly strengthen SSN programs' ability to deliver benefits in a timely manner. Currently, individuals registering for a SSN program – especially in the less developed contexts – often lack a reliable means of receiving electronic transfers from the government or must rely on unreliable or temporary means of payment subject to frequent change (such as mobile phone numbers). Consequently, at the time of registration for a SSN program, some applicants may be unable to provide valid payment data or may enter payment information that becomes outdated within a few months or years. SSN programs typically address this problem by conducting additional payment data collection around the time of payment disbursement to obtain updated information or create new payment accounts. This redundant capture of payment data leads to additional administrative costs and delays in benefit delivery, which are especially problematic for emergency responses, when timely payments to crisis-affected populations are critical. Establishing permanent CBDC wallets would reduce or eliminate the need for confirming payment data and therefore simplify the logistics of registration and enrolment processes.

Apart from streamlining the payment delivery process, permanent CBDC wallets can insulate beneficiaries' ability to receive and make payments from the challenges faced by private financial institutions. While a government could mandate private financial institutions to create and maintain permanent accounts for individuals through legislation, this approach would still leave permanent accounts dependent on private sector

[24] A permanent CBDC wallet would be a wallet provided by birth by the government for each citizen and extend the utility of the tax payment accounts beyond just receiving tax refunds to encompass a variety of government payments, including those related to SSNs.

institutions, which may experience default. A CBDC wallet residing on a CBDC platform outside of any specific FI – even if custodied by a CBDC-participating bank – can be better insulated from the risks of private sector FIs.

The prospect of access to CBDC transaction ledgers by parties other than payment providers could lead to improvements in payment reconciliation through automation and enable the generation of real-time reconciliation reports on the CBDC platform, which would significantly reduce the lag in reconciliation and error-correction. Under the conventional SSN implementation arrangements, SSNs transfer the total amount of funds to payment service providers for delivery to individual recipients. Following the delivery of payments to individual beneficiaries, payment service providers produce reconciliation reports that match the value of transfers to the sum of executed transactions to detect any unspent balance. Reconciliation exercises typically involve coordination between payment service providers and the flow of data between their databases and the SSN MIS. Given that the CBDC platforms would maintain semi-public restricted access ledger, it would be possible to either automate the reconciliation process such that SSN administrators can generate reconciliation reports on their own or engage third parties with sufficient ledger access rights who would be able to undertake reconciliation and handle resolution with payment service providers.

The potential of auditable ledgers to improve transparency, control, and reporting of government payments through a blockchain-based ledger has been explored in an IMF-supported project in Guinea-Bissau. The project established a blockchain platform which created a virtual ledger for government compensation spending on wages and salaries. The platform produces an immutable and transparent ledger of government payments, securely processes wage payment data, monitors in real-time the eligibility, budgeting, approval of payments, and the final disbursement of wages of government employees, detects inconsistencies in the payment data, and generates fiscal reports almost in real-time (IMF, 2024b). A similar functionality can be achieved on a CBDC platform with respect to SSN transfers.

CBDC wallets can be programmed by means of smart contract in ways that simplify recovery of misdirected or unspent funds after they have been deposited by public institutions in beneficiary wallets. SSNs transfers may be sent to the wrong recipient in the incorrect amount or on an incorrect date. Additionally, SSNs may be unused by beneficiaries, which may be seen as an ineffective use of public funds intended to address immediate needs. Currently, general purpose deposit accounts tend to treat all transfers – public or private – the same, which makes recovery of erroneous payments a difficult process. CBDC wallets could potentially help establish funds recovery mechanisms. However, such controls raise privacy concerns and would require appropriate regulatory foundation for a government agency to access funds in beneficiary wallets. For instance, some type of contract or consent may have to accompany the creation of a wallet that has a fund recovery functionality.

CBDC wallet limits may carry the risk of payment delivery failure and need to be managed carefully. Limits on CBDC wallets can be implemented for two reasons: (1) to ensure financial stability and transmission of monetary policy in order to avoid bank disintermediation in times of financial crisis or in times of negative interest, and (2) to safeguard financial integrity by restricting the access to anonymous money to low value transactions and low caps on holdings without full CDD. While lower wallet limits have been used in conjunction with relaxed CDD requirements to improve CBDC adoption, they can be too restrictive for SSN transfers. In some cases, SSN transfers can be substantial, especially if payment delivery cycles of several SSN programs overlap or in case of large transfers (e.g., humanitarian response transfers intended to mitigate the impact of significant shocks, such as loss of livelihood due to floods). Restricted CBDC wallet sizes can then result in failed payments and should be calibrated to optimize payment delivery accuracy versus monetary policy

transmission and capital flow management. Wallet programmability can potentially address this problem by waiving wallet size restrictions for government payments only. Alternatively, overflow mechanisms can be introduced where over-the-limit funds are transferred to traditional deposit accounts. This would, however, lead to a beneficiary dependence on bank accounts and reduce the role of CBDC wallets as independent payment instruments and a tool for financial inclusion.

4.4 Benefit administration and beneficiary management

For the purpose of improving benefit administration and management, three CBDC features have the greatest potential impact:

- Accessibility of the ledger for review and analysis
- ID-linked CBDC wallets
- Programmability of transactions

4.4.1 Conditional transfers

The execution of conditional payments[25] can be streamlined through the automation of compliance verification for beneficiaries with program conditions. Conditional Cash Transfers (CCTs) are benefits paid when beneficiary households meet certain conditions or co-responsibilities. Advanced programmable CBDC platforms, using smart contracts, can further automate the implementation of conditional payments, provided the smart contract can access information verifying the disbursement conditions have been satisfied. For example, consider the case of a CCT that incentivizes poor households to obtain immunizations for children under 5, compensating clinics for administering an immunization for the cost of supplies and service provision. Under a conventional implementation modality, immunization clinics administer immunizations to a broad range of individuals and must maintain records of their IDs, including identifying SSN beneficiaries and periodically reporting this information to the SSN MIS. The SSN MIS would then designate the beneficiary as compliant with CCT requirements and initiate a payment transfer. This process typically requires multiple levels of approval, leading to delays of several days to weeks before the payments reach beneficiaries. In contrast, a smart contract on a CBDC platform could automate the transfer of funds to both the beneficiary and the clinic immediately upon verification that an individual identified as a CCT beneficiary obtains an eligible immunization for an eligible child. The Australia case study described in section 3 documents similar automated execution of transactions involving products and services compliant with beneficiaries' individual treatment plans between authorized vendors and beneficiaries (Royal et al., 2018).

Tokenization represents a significant challenge to automating CCTs on CBDC platforms, especially in settings where service providers do not maintain digital or paper records. The execution of smart contracts requires confirmation of compliance with program conditions based on tokenized (i.e. digital) proof. In the immunization example, at least four real-life events or assets needed to be tokenized: the immunization recipient, the vaccine, the clinic, and the administration of the immunization itself. Once all four tokenized proofs are obtained, the smart contract can execute the transfers. Tokenization challenges are stem from (1) the lack of digital documentation (e.g., electronic records of vaccine stocks and their distribution), which would facilitate

[25] There is a common view among central banks that CBDCS should function as generally available money, i.e. simillarly to cash. This would mean that CBDCs as money should be unconditional but a third party could impose conditions regarding access or use in accordance with law or contract.

the task of tokenization, and (2) lack of mechanisms for ensuring trustworthiness of tokens (this can be addressed in a number of ways: for instance, through triangulation of token validity across multiple data sources or certifying or otherwise assuring the validity of tokens). However, tokenization issues are industry-wide challenges for the fintech sector aiming to advance automation, and solutions are actively being pursued. Proof-of-concept designs for the tokenization of crops and subsidized loan administration in Brazil suggest that this is feasible in principle (Howard and Smith, 2023; Orestes and Townsend, 2023), but scalability of tokenization remains a concern.

As government programs, CCTs may be able to implement simplified tokenization approaches that are not suited for standard defi applications of tokens for fully trustless contracts. One core assumption within the defi context is that parties providing information that triggers contract execution cannot be trusted, which is a reasonable assumption for private actors who may have incentives to distort information to manipulate smart contracts. However, in cases where SSN agencies are part of a well-trusted, transparent, and accountable government, they may claim a higher trust profile and use simplified tokenization solutions. For example, they could (a) designate a limited list of certified service providers[26] who would adopt pre-established quality control procedures to ensure reliability of their tokenized conditionality compliance records, or (b) rely on the conditionality compliance module of the SSNs MIS, which implement their own procedures to ensure the accuracy of compliance data.[27] Verification of beneficiary's identity, which is one of the compliance conditions, can be significantly simplified through the use of biometric IDs, especially if these IDs are stored on the CBDC platform and can be easily accessed without needing to connect to an external API of the national ID system.

If tokenization challenges can be resolved, the automation of conditional transfers can lead to significant gains in efficiency of implementation and cost savings, especially in cases where the conditions for the execution of benefits are complex. Efficiency gains are documented in case studies of school feeding in Kazakhstan, asset tokenization in Brazil, and disability services provision in Australia. In the latter case, NDIA's payment conditions vary according to each client's disability profile and course of treatment, which created plenty of room for efficiency gains and costs savings, as documented in the pilot (Royal et al., 2017).

4.4.2 Beneficiary information updates, beneficiary recertification, grievance redress management, and performance monitoring

For information updates, permanent ID-linked wallets would have the greatest impact on beneficiary information accuracy. Permanent wallets would minimize the need to update payment information, which may only need to be revised for those beneficiaries who opt to have their benefits delivered into private deposit accounts, if such an option is permitted.

When SSN administrators or third parties acting on their behalf can access the CBDC ledger, CBDCs can enhance beneficiary recertification, grievance management related to payment delivery, and regular monitoring and analysis of SSN transfers. With access to the transaction ledger, SSN administrators can respond more expeditiously to beneficiaries' inquiries related to their payments because they will be able to address these

[26] One of the implementation modalities tested in Australia's NDIS pilot involved purchasing services from a panel of providers approved by the NDIS as a way of ensuring that service provision met project requirements (Royal et al., 2017).

[27] Kazakhstan's school feeding program used such a simplified modality, when swipes of students' meal cards were kept in a separate database and the number of swipes per canteen was used as an input in the smart contract to initiate a transfer of a given amount. Thus, instead of executing each individual meal purchase by a student on the blockchain, a single transaction representing the total value of a batch of purchases was executed.

queries directly without needing to relay them to payment service providers.[28] Similarly, access to CBDC ledgers would facilitate monitoring of payment transactions. Separate monitoring arrangements would have to be in place for any transactions that are not conducted on the CBDC network. CBDC platforms can potentially support automated processing and analysis of their data through dashboards. While the same could be done by traditional payment service providers, this requires special cooperation efforts that would likely run into barriers due to banking regulations.

4.5 Use of benefits

CBDC platforms can enable SSN agencies to exercise control over the use of benefits through the programmability of wallets and transactions. SSN beneficiaries need to be able to use their benefits to purchase goods and services to meet their needs. Using benefits requires either converting digital benefits into physical cash, making digital payments, or converting them into cash-like instruments (e.g. balances on pre-paid cards or off-line CBDC instruments). It is common for beneficiaries to “cash out” their benefits at bank branches or through agents of mobile operators. In some cases, beneficiaries can make mobile payments to service providers in a closed-loop system without having to cash out if providers accept mobile payments. In addition to enabling delivery of benefits based on ex ante compliance with program conditions, CBDC platforms can regulate the use of benefits by programming wallets to apply benefit conditions ex post. For instance, the Reserve Bank of India envisions programming CBDC wallets to limit spending of social transfers to eligible expenses only (Reserve Bank of India, 2022).

Smart contracts attached to CBDC wallets[29] would facilitate the implementation of conditional use of funds on the same CBDC network. Ex post conditionality can be implemented outside of CBDC platforms or blockchain, but usually such programs require creating separate special purpose accounts. A notable example is the Supplemental Nutritional Assistance Program (SNAP)[30] in the United States, which limits the use of benefits to food items, excluding products such as tobacco, alcohol, restaurant food, and vitamin supplements. However, SNAP operates on a stand-alone electronic benefit transfer (EBT) network with a dedicated payment instrument, the EBT card.[31] Smart contracts attached to CBDC wallets can enable implementation of ex post conditions on the same CBDC network, effectively making SNAP functional on a regular bank deposit network.

Theoretically, any number of distinct conditional benefit use programs can be implemented as smart contracts on the CBDC network, which can generate significant efficiency gains. For instance, smart contract A would execute transfers according to conditions of SSN program A and smart contract B would apply algorithms to execute conditions of SSN program B, without the need of establishing, maintaining, and managing separate networks for each of these programs.

Programmability of CBDCs can enable third parties – such as fintech companies – to potentially develop products designed to meet conditionalities. In the Brazil case study, a third-party fintech firm is planned to

[28] Data that comes from CBDC platforms could include payment disbursements, payment reconciliation, success in fund reaching beneficiaries, funds used (in some cases funds may reach an account but never be used), and possibly even the type of products and service purchased.

[29] Most the smart contracts would be implemented over the wallet layer, especially if they involve customized user experience. However, some smart contracts would operate at the platform layer. For instance, it may be more efficient to implement checks against "do-not-pay" lists and other CDD protocols using platform layer smart contracts.

[30] Also knows as Food Stamps.

[31] See https://benefits.com/food-stapms/snap-ebt-card/

provide tokenization services to banks to enable them to participate in the provision of subsidized agricultural loans. Similarly, SSN programs with ex post conditions can create demand for services and products tailored to meet those conditions. For instance, in the case of SNAP, provision of store item scanning services to small grocery stores can help them automate processing of SNAP payments. To enable such third-party participation, CBDC platforms should maintain a relatively open architecture and introduce fintech-friendly regulations. Further, the CBDC technology stack can be used as a technology layer that improves the functioning of and coordination between traditional payment services providers. For instance, Ghani et al. (2024) document a blockchain-based solution that enabled execution of mobile payments across multiple MNO networks which were not initially set up for interoperability. The solution used a private stablecoin rather than a CBDC, but the same functionality can be achieved through CBDCs with even greater ease (no need for stablecoin conversion) and with no potential risks or regulatory hurdles involved in using stablecoins.

5. CBDCs versus other payment solutions

While many of the features offered by CBDC platforms are not typically available through conventional financial institutions and payment service providers, many of these features could conceivably be implemented using existing technological solutions within the current financial institutional infrastructure. For instance, open finance efforts that promote standardization of financial accounts and transactions represent an alternative to CBDC platforms for enhancing interoperability across different financial institutions. Achieving interoperability through open finance can facilitate information sharing and creation of shared ledgers. Additionally, universal payment interfaces that streamline payments across clients of different financial institutions in near real-time have also emerged as a trend (India's UPI, Brazil's PIX, or Colombia's Daviplata) aimed at minimizing friction in the payment space. Furthermore, blockchain solutions can be deployed on standalone blockchain platforms provided by public or private third parties that operate in combination with traditional payment systems. The concurrent development of CBDC platforms and these other solutions suggest that there may not yet be a clear winner between among these different approaches. Table 5 assesses the extent to which existing payment solutions can deliver functionalities similar to that of CBDC platforms for SSN delivery in alternative ways, i.e. without the use of CBDC platforms. We compare the following types of existing payment systems:

1. Bank deposit accounts with traditional batch settlement: Batch settlement is often characterized by lengthy batch cycles and settlement system downtime[32], a focus on high-value transactions, and low integration of mostly siloed financial institutions.
2. Fast payment system (FPS): this is characterized by the integration of APIs from all or key financial institutions into a single network to achieve near-instant settlement of balances between participating institutions.
3. Mobile Network Operator (MNO)-based payment system: This is a system that substitutes settlement across MNO accounts in an MNO network for settlement between financial institutions. MNOs maintain their own ledgers of transactions to and from mobile phone accounts. A crucial feature of the MNO-based payment system is that every mobile number holder can receive and make cashless payments, and the technology required for it is basic SMS messaging. Yet MNOs are not banks and hold their funds in institutional bank accounts, which are settled periodically.
4. FPS with open finance: Open finance involves greater standardization of storing and sharing financial information beyond accounts between PSPs participating in the FPS and therefore implies greater interoperability between banks who are already API-integrated. Brazil's Pix system and India's Account Aggregator ecosystem are examples of building open finance functionality into FPS.[33]
5. FPS with blockchain This is a payment system architecture where blockchain solutions are implemented by third parties but are interoperable with FPSs. Under this design, providers of independent blockchain platforms could provide wallets on the blockchain funded with tokenized deposits from FPS-linked accounts. Programmable functionality is executed on independent platforms (government or private). Fund transfers would be implemented over the FPS upon instructions from smart contract on the blockchain. Centiglobe is an example of a provider of such an independent blockchain platform (Centiglobe, 2025). (Centiglobe 2025).MNOs with blockchain: This is similar in

[32] Even real-time gross settlement (RTGS) systems tend to be non-operational for several hours per day with the effect that payments not included in the last batch of the day will be settled the day after. However, when the RTGS are up and running, the settlement itself occurs quickly within seconds or minutes. More recent implementations of the RTGS system achieve nearly 24/7 uptime.

[33] See World Bank (2023).

principle to the previous "FPS + blockchain" solution, but smart contracts send fund transfer instructions over the MNO network. Basic mobile phone devices can be used to initiate transactions on the blockchain. Some MNOs - such as China Telecom, Telcoin, Telefonica, and MTN – have offered blockchain defi products over their and partners' mobile networks.[34]

Table 4. Ability of existing payment solutions to deliver benefits offered by CBDCs in alternative ways (i.e. without CBDC solutions)

Existing payment solutions	*Functionality enabled by CBDCs*					
	Instant or near instant settlement	*SSN agency has control over transactions on payment platform*	*SSN agency has access to ledger*	*Permanent wallet creation*	*Programmable **without** tokenization*	*Programmable **with** tokenization*
Bank accounts system (batch)	No - batches are processed periodically	No	No	Possible, but would be a standalone system of government accounts to ensure independence from private banks	Possible to implement some basic programmed functions at the bank level, but difficult because of regulations and because each bank would have to program functions separately. Standardization of inter-bank transactions would take long Programmability can be implemented in the SSN MIS	No - because blockchain is required for tokenization. However, programmability with tokenization can be implemented in the SSN MIS
FPS	Yes	No	No	Possible, but would be a standalone system of government accounts to ensure independence from private banks	Possible to implement some basic programmed functions at the bank level, but difficult because of regulations and because each bank would have to program functions separately unless standardization is achieved. API integration and instant settlement helps programmability. Programmability can be implemented in the SSN MIS.	No - because blockchain is required for tokenization, However, programmability with tokenization can be implemented in the SSN MIS
MNO	Possibly. Near-instant transfers of funds between individual MNO numbers, but final settlement depends on whether MNOs operate in batch or	No	No	No – creating a permanent wallet on MNO network is not possible due to churning of SIM cards and mobile phone number	Possible to implement some basic programmed functions at the MNO level, but the execution of these programmed functions would require coordination with MNOs. More flexibility than with banks. Each MNO would have to program functions separately. Programmability can be implemented in the SSN MIS.	No - because blockchain is required for tokenization. However, programmability with tokenization can be implemented in the SSN MIS

[34] See The Block (2024), Telcoin (2025), Telefonica (2022), Wirepro (2020).

	FPS environment					
FPS + open finance	Yes	No	No	Possible, but would be a standalone system of government accounts (to ensure independence from private banks) with better interoperability with private banks through API integration with FPS	Open finance measure may support better programmability across banks in addition to API integration, but programmed functions would still be rather basic. Improving programmability would require significant coordination and standardization efforts. Greater programmability possible outside of payment system through the SSN MIS.	No - because blockchain is required for tokenization. However, programmability with tokenization can be implemented in the SSN MIS
FPS + blockchain	Yes	Partial, since banks would still have to execute transfer request	Yes	Possible to have a permanent wallet on a government blockchain but it would still need to link to a non-permanent private deposit account.	Yes. Programmability would be exported to the blockchain. This would be in addition to any programmability implemented through the SSN MIS.	Yes. Programs involving tokenization would be run on an external blockchain. This would be in addition to any programmability implemented through the SSN MIS.
MNO + blockchain	Yes	Partial, since banks would still have to execute transfer request	Yes	Possible to have a permanent wallet on a government blockchain but it would still need to link to a non-permanent MNO mobile number.	Yes. Programmability would be exported to the blockchain. This would be in addition to any programmability implemented through the SSN MIS.	Yes. Programs involving tokenization would be run on the external blockchain. This would be in addition to any programmability implemented through the SSN MIS.

Existing payment solutions can deliver near real-time speed of transactions and security of settlement, but at present they have limited ability to support programmability across numerous financial institutions, even when open finance regulations and practices are implemented.

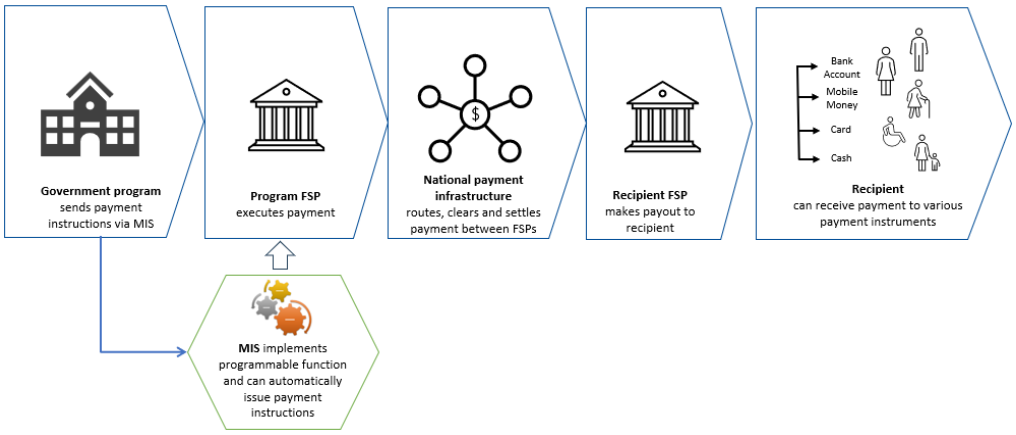
At the same time, within the current SSN payment ecosystem, the lack of advanced functionality at the level of payment solutions as such can be addressed through programmability of SSN MIS. In existing SSN delivery ecosystems, programmable functionality is implemented within SSN MIS, i.e. outside the payment system rails. However, CBDC platforms can take on some of the programmable functions that are currently implemented through SSN MIS, as illustrated in Figure 5. The optimal approach depends on the context and nature of tasks that are being programmed. For instance, the Kazakhstan school feeding case study shows that the CBDC

platform can execute transfers based on data (number of card swipes) collected in an MIS external to the CBDC platform.

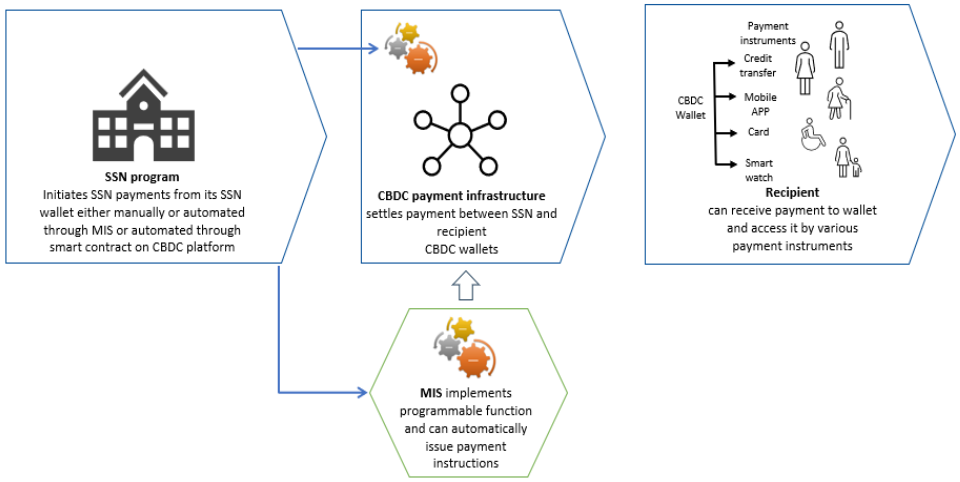
Existing payment solutions, even when integrated with blockchain platforms, remain dependent on payment service providers. Figure 5a shows that in traditional payment arrangements, transfers are executed by PSPs that control deposit or mobile money accounts of both SSN programs and recipients, which lowers the autonomy of SSN administrators in payment execution and may result in additional fees and coordination arrangements, although, FSPs' API integration could mitigate some of these costs and challenges.

Figure 5. Traditional and CBDC-supported SSN payment process design

A. Traditional SSN payment process design



B. CBDC-supported SSN payment process design



Thus, the choice between a traditional SSN payment design and a CBDC-supported one would depend to some extent on the capabilities of the MIS and whether the smart contracts that can be executed on the CBDC platform significantly outperform the programmable functions of the MIS. Furthermore, under a CBDC-enabled

payment process design, SSN MIS can still be used, taking on programmable functions that may not be executed efficiently via smart contracts on the CBDC platform.

Additionally, programmability can be “injected” into the existing SSN payment process through standalone blockchains, either publicly or privately run. Such a standalone blockchain solution would constitute a network of wallets funded from traditional bank accounts or MNO payment accounts.

6. Conclusion

6.1 Key findings

The preceding sections show that CBDC platforms have the potential to introduce improvements throughout the entire SSN delivery chain. The majority of the improvements are linked to the following capabilities of CBDC platforms:

- The ability to create permanent CBDC wallets.
- Enabling SSN agencies to execute transactions autonomously, thereby limiting their dependency on financial institutions for payment delivery and administration.
- Providing access to the ledger for a wide range of authorized entities.
- Supporting advanced programmability (including tokenization) and broad scope for automating payment delivery and administration, including through participation of third parties.

Table 5. Degree of potential impact of different CBDC design features on the SSN delivery chain

SSN delivery chain element	*SSN agency control over transactions*	*Access to CBDC ledger*	*Permanent wallet availability*	*Programmable **without** tokenization*	*Programmable **with** tokenization*
Identify	Not relevant	Not relevant	High	Not relevant	Not relevant
Assess and select	Not relevant	Moderate	High	Not relevant	Moderate
Pay	High	Moderate	High	High	High
Administer	Moderate	High	High	High	High
Use	High	High	High	High	High

Classification: (High = highly transformative, Moderate = moderately transformative, low = weakly transformative)
Source: Authors' presentation.

The key benefits that CBDCs provide for the SSN delivery chain relate to enhancing SSN administrators' capacity to manage payment delivery and use, due to support for peer-to-peer transactions, decentralized access to the transaction ledger and programmability. However, the benefits of CBDCs as payment rails in the narrow sense are not as evident since near real-time transaction speeds can be achieved through FPS that leverage API integration of traditional FSPs and settlement security can be effectively promoted through RTGS settlement and deposit insurance. Nevertheless, CBDCs have the potential to improve crisis resilience of financial systems by establishing standalone payment rails that would theoretically be unaffected by private bank failures.

In the specific context of SSN delivery, it is important to assess the extent to which CBDCs offer benefits over existing SSN delivery approaches. The payment administration functionality provided by CBDCs can potentially be achieved through other means, specifically through improved SSN MIS, introducing open finance practices, or third-party blockchains.

6.2 Final observations and analytical considerations

- CBDCs could have a transformative effect on SSN delivery. In contexts where CBDCs are being introduced or implemented, their potential role in SSN delivery merits consideration.
- Large-scale implementation of advanced CBDC features may hinge on the development of an ecosystem of institutions capable of providing CBDC-related services, including smart contract development, testing and auditing tokenization and ledger analysis. Experience suggests that developing such institutional infrastructure typically takes time and significant capacity building, including for SSN agencies (IMF, 2023, and IMF, 2024a).
- Even in settings where CBDCs have been rolled out, questions remain regarding their viability and effectiveness. Challenges observed to date include low adoption rates, high digitalization requirements, and low public trust in CBDC governance.
- Evidence to date suggests that CBDC platforms should not be viewed as a replacement for traditional SSN designs at this stage. Additional experimentation with various delivery modalities could help clarify the administrative and financial costs and benefits of SSN delivery using CBDC platforms compared to conventional SSN delivery designs or hybrid approaches.
- Expansion of national biometric ID systems appears relevant for improving both traditional and CBDC-based SSN delivery chains.
- At present SSNs seem to have more to offer to CBDCs than the other way around. In some contexts, SSNs programs may serve as a pathway to stimulate demand for CBDCs, for example by channeling government transfers into CBDC wallets.

Acronyms

AML Anti-Money Laundering

API Application Programming Interface

BIS Bank for International Settlements

CCT Conditional Cash Transfer

CBDC Central Bank Digital Currency

CFT Combating the Financing of Terrorism

CPMI Committee on Payment and Market Infrastructures

CPSS Committee on Payment and Settlement Systems

DLT Distributed Ledger Technology

DREX Brazil's Digital Real Platform

FI Financial Institution

FPS Fast Payment System

G2P Government to People

CDD Know Your Customer

MNO Mobile Network Operator

NFT Non-fungible Token

NIN National Identification Number

P2P Peer to Peer

PIX Brazil's Instant Payment System

PSP Payment Service Provider

R-CBDC Retail Central Bank Digital Currency

RTGS Real Time Gross Settlement

SP Social Protection

SSN Social Safety Nets

UX User Experience

W-CBDC Wholesale Central Bank Digital Currency

Glossary

Application programming interface (API) are sets of rules that enable interaction between different applications.

Blockchain is a decentralized ledger of data that is shared and stored in blocks that are linked together in a chain.

Central bank digital currencies (CBDCs) are a digital form of money issued by the central bank, as well as the technology platform that enables CBDC transactions.

Customer due diligence (CDD) is set of regulations and procedures used by financial institutions to verify the identity of their customers.

Defi refers to non-traditional financial institutions that facilitate peer-to-peer transfers using the blockchain and distributed ledger technology.

Distributed ledger technology (DLT) is a type of database that enables multiple participants joined in a network to share and synchronize copies of a ledger across the entire network. DLT allows for a secure way to conduct and record transactions without a central authority.

Fiat money is a government-issued currency that is made legal tender by government decree and whose value is not backed by a physical commodity such as gold or silver.

Government-to-person (G2P) payment system is sets of procedures and technological solutions used by governments to deliver payments to individuals.

Mobile network operator (MNO) is a company that provides wireless communication services to mobile phone users.

Non-fungible token (NFT) is a unique digital identifier recorded on the blockchain that certifies ownership and authenticity of a digital or physical asset. An NFT cannot be copied, subdivided, or altered.

Off-line CBDC payments refer to those payment solutions that enable transfer of tokens without online access to the CBDC network and its token validation functionality.

Payment delivery solutions are sets of technologies and procedures geared toward delivering payments.

Payment administration solutions are sets of technologies and procedures geared toward delivering payments as well as managing payments, i.e. when and under what conditions payments are made, how the received funds can be spent; as well as activities that accompany successful delivery and use of payments, such as monitoring, handling of complaints, reporting, etc.

Payment service providers (PSPs) are institutions that are authorized to provide payment services under a qualifying license, usually a banking or a payment service provider license. For instance, mobile network operators (MNOs) may hold PSP licenses and therefore able to execute mobile payments.

Retail central bank digital currencies (R-CBDCs) are digital money issued by central banks for use by the general public.

Social safety nets (SSN) programs aimed at providing assistance to poor, vulnerable, and shock-affected persons and households usually financed from the general budget, i.e. non-contributory.

Technology stack is a set of technologies (e.g., software and hardware components) intended to work together to deliver a solution.

Tokenization refers to generating digital token that is a trusted and secure (invulnerable to manipulation) representation of a specific real-life asset or event.

Tradfi denotes traditional financial institutions such as banks, stock exchanges, credit card companies, etc., which are characterized by centralized organization and heavy regulation.

Wholesale central bank digital currencies (W-CBDCs) are issued by central banks for settling wholesale settlement of transactions between banks and other financial institutions like the Real Time Gross Settlement system (RTGS).

References

Bird, Nicolò and Emine Hanedar (2023). "Expanding and Improving Social Safety Nets through Digitalization: Conceptual Framework and Review of Country Experiences." NOTE/2023/007. Washington, DC: International Monetary Fund, December, URL = <https://www.imf.org/en/Publications/IMF-Notes/Issues/2023/12/07/Expanding-and-Improving-Social-Safety-Nets-Through-Digitalization-Conceptual-Framework-and-541091>.

Branch, Sharon, Lynsey Ward, and Allan Wright (2023). "The Evolution of the SandDollar," Intereconomics, 58(4), 178-184.

Bull, Gretta, William Cook, Mehmet Kerse, Stefan Staschen (2021). "Is Financial Inclusion a Reason to Push Central Bank Digital Currencies?", CGAP Blog, May 13, URL = <https://www.cgap.org/blog/is-financial-inclusion-reason-to-push-central-bank-digital-currencies>.

Centiglobe (2025). URL = <https://www.centiglobe.com/>.

Central Bank of Nigeria (2024). URL = <https://enaira.gov.ng/for-individuals/>.

Das, Mitali, Tommaso Mancini Griffoli, Fumitaka Nakamura, Julia Otten, Gabriel Soderberg, Juan Sole, and Brandon Tan (2023). "Implications of Central Bank Digital Currencies for Monetary Policy Transmission," Fintech Notes, NOTE/2023/010 . Washington, DC: International Monetary Fund.

Di Iorio, Alberto, Anneke Kosse, and Ilaria Mat (2024). "Embracing Diversity, Advancing Together – Results of the 2023 BIS Survey on Central Bank Digital Currencies and Crypto." BIS Paper 147, June.Ghani, Tarek, Michael Callen, Miguel Fajardo-Steinhäuser, and Michael Findley (2024). "Can Digital Aid Deliver During Humanitarian Crises?". Forthcoming.

Howard, Sean and Stuart Smith (2023). "Applying Programmable Finance to the *Real Digital* and Brazilian SME Economy"in LIFT Papers: Revista do Laboratorio de Inovacoes Financeiras e Tecnologicas, #5, April 2023. URL = <https://www.pymnts.com/cbdc/2023/visa-builds-programmable-finance-pilot-for-brazilian-farmers-using-cbdc/>.

International Monetary Fund (2023). "IMF Approach to Central Bank Digital Currency Capacity Development". April 11. URL = https://www.imf.org/en/Publications/Policy-Papers/Issues/2023/04/12/IMF-Approach-to-Central-Bank-Digital-Currency-Capacity-Development-532177

International Monetary Fund (2024a). "Central Bank Digital Currency: Progress and Further Considerations". November 8. URL = https://www.imf.org/en/Publications/Policy-Papers/Issues/2024/11/08/Central-Bank-Digital-Currency-Progress-And-Further-Considerations-557194

International Monetary Fund (2024b). "Guinea-Bissau is Using Blockchain to Boost Fiscal Transparency". October 4. URL = < https://www.imf.org/en/News/Articles/2024/10/02/cf-guinea-bissau-is-using-blockchain-to-boost-fiscal-transparency>.

Kim, Sung Ho, "Max Weber", The Stanford Encyclopedia of Philosophy (Winter 2024 Edition), Edward N. Zalta & Uri Nodelman (eds.), URL = <https://plato.stanford.edu/archives/win2024/entries/weber/>.

Koonprasert, Tayo Tunyathon, Shiho Kanada, Natsuki Tsuda, and Edona Reshidi (2024). "Central Bank Digital Currency Adoption Inclusive Strategies for Intermediaries and Users." Fintech notes, NOTE/2024/005,

Washington, DC: International Monetary Fund. September. URL= <https://www.imf.org/-/media/Files/Publications/FTN063/2024/English/FTNEA2024005.ashx>.

Lannquist, Ashley and Brandon Tan (2023). "Central Bank Digital Currency's Role in Promoting Financial Inclusion," Fintech notes, NOTE/2023/011, Washington, DC: International Monetary Fund. September, URL = <https://www.imf.org/en/Publications/fintech-notes/Issues/2023/09/22/Central-Bank-Digital-Currency-s-Role-in-Promoting-Financial-Inclusion-538728>.

Lavayssiere, Xavier and Nicolas Zhang (2024). Programmability in Payment and Settlement: Concepts and Implications. WP/24/177. Washington, DC: International Monetary Fund, August, URL = <https://www.imf.org/en/Publications/WP/Issues/2024/08/15/Programmability-in-Payment-and-Settlement-553493)>.

Ledger Insights (2023). "Nigeria Using ENaira CBDC to Disperse Aid Including Farmer Loans" , May 4, URL = <https://www.ledgerinsights.com/nigeria-enaira-cbdc-disperse-aid-agricultural-loans/>.

National Bank of Kazakhstan and National Payment Corporation of Kazakhstan (2023). Digital Tenge: Results of the First Implementation Phase: White Paper 2023.

Orestes, Victor and Robert M, Townsend (2023). Brazil's Central Bank Digital Currency: Improving Financial Infrastructure with Programmability. LIFT Papers: *Revista do Laboratório de Inovações Financeiras e Tecnológicas, #5 | ABRIL 2023.*

Reserve Bank of India (2022). "Concept Note on Central Bank Digital Currency." Fintech Department, October.

Royal, Daniel, Paul Rimba, Mark Staples, Sophie Gilder, An Binh Tran, Ethan Williams, Alex Ponomarev, Ingo Weber, Chris Connor, and Nicole Lim (2018). "Making Money Smart: Empowering NDIS Participants with Blockchain Technologies." Commonwealth Bank of Australia and Data61 (CSIRO), Sydney, Australia.

Telcoin (2025). URL = <https://www.telco.in/en/about-company>.

Telefonica (2022). "Telefónica Tech Partners with Polygon to Develop Web3 Solutions". URL = < https://www.telefonica.com/en/communication-room/press-room/telefonica-tech-partners-with-polygon-to-develop-web3-solutions/>.

The Block (2024). URL = <https://www.theblock.co/post/239063/bank-of-china-tests-sim-card-nfc-payments-for-digital-yuan>.

Wezel, Torsten and Jack Ree (2023). Fostering Financial Inclusion through Digital Financial Services Nigeria, SIP/2023/020, Washington, DC: International Monetary Fund, March.

Wirepro (2020). "Blockchain in Telecoms – Do We Want to Make that Jump?", March. URL = < https://www.wipro.com/business-process/blockchain-in-telecom-do-we-want-to-take-that-jump/#:~:text=Airtel%20%E2%80%93%20Telecom%20organizations%20have%20started,more%20secure%20with%20ID%20verifications.>.

World Bank (2020). Sourcebook on the Foundations of Social Protection Delivery Systems. Edited by Kathy Lindert, Tina George Karippacheril, Inés Rodríguez Caillava, and Kenichi Nishikawa Chávez. Washington, DC.

World Bank (2023). Open Finance in the Context of Fast Payment Systems. August. URL = <https://fastpayments.worldbank.org/sites/default/files/2023-09/Open%20Banking%20and%20FPS_Final_August%2028.pdf>.

PUBLICATIONS

Can Central Bank Digital Currencies Improve the Delivery of Social Safety Nets?

Working Paper No. WP/2025/211