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Digital Currency Implementation Checklist for Central Banks

Regulatory Requirements and Economic Impact Working Group

Focus Group Technical Report

FOREWORD

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Digital Currency Implementation Checklist for Central Banks

About this report

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1 Introduction

The purpose of this document is to provide a summary of issues and considerations for policymakers considerations adoption of Digital Fiat Currency. Instead of presenting a definitive, one-size-fits-all set of answers, the document is instead structured as a checklist, in order to facilitate further discussion amongst stakeholders. It is comprised of a series of questions, with accompanying discussion and commentary, and is divided into four broad and somewhat fluid topic areas: Design and Infrastructure, Policy & Regulation, Interoperability; and Implementation.

2 Design and Infrastructure

2.1 Is the DFC network going to be a token-based or account-based system, or some combination?

Discussion: Account-based systems are actor-centric, while token-based systems are object-centric. Each has specific benefits and disadvantages relating to interoperability, (de)centralization, efficiency, and security. The relative merits of the two approaches have been discussed in depth elsewhere in the CBDC and DFC literature, and ultimately depends on the specific needs and goals of the jurisdiction in question.

2.2 Will interest be paid on DFC balances? If so, how much, and under what conditions?

Discussion: In contexts where the goal of implementation of DFC is merely to replace physical coins and paper currency, the capacity to pay interest directly on DFC balances is of less importance. Conversely, if the aim of introducing DFC is to precipitate a broader reorganization of the payments system, the ability to pay interest directly on DFC balances may be important to the implementation of monetary and fiscal policy, as well as for preserving technical features of the existing payments system (i.e. the capacity to pay interest-on-reserves).

2.3 Will DFC funds have durational features? If so, how much, and under what conditions?

Discussion: DFC instruments are commonly thought of as a digital equivalent to cash instruments, or a retail-accessible form of digital reserve balances, both of which have zero duration. However, in the modern central banking era, government securities accounts also operate on similar payments and accounts infrastructure. Hence, DFC has the potential to perform other functions that involve duration, such as providing consumer savings and/or investor securities accounts, and also serving as the settlement layer for smart contracts and financial trading platforms.

2.4 Will payments be instantaneous, or delayed?

Discussion: It is often assumed that instantaneous settlement is inherently superior to delayed settlement, however there are architectural and policy reasons to favor processing delays in certain contexts, such as to encourage batching and/or to allow for third-party validation of transactions. Depending on context, it may be desirable to allow for both real-time settlement and delayed settlement for different functions and actors within the same DFC ecosystem.

2.5 Will settlement be final or reversible? If so, under what conditions?

Discussion: Settlement finality greatly simplifies transactional dynamics, and insulates the payments network itself from potentially disruptive regulatory or intermediary intervention. On the other hand, finality may be undesirable from a law enforcement and/or risk-allocation perspective, and attempts to impose finality may simply incentivize additional intermediary layers to emerge on top of the DFC payments infrastructure, similar to the emergence of credit cards on top of the banking system. Determining the optimal degree of finality will depend on the needs and goals of the specific jurisdiction.

2.6 Will certain kinds of transactions be prohibited at the technical layer? What?

Discussion: It is possible to design a DFC system to allow for discrimination and censorship on a transaction-by-transaction basis. Doing so would further a range of law enforcement and security interests. However, such interests must also be weighed against privacy and security considerations. Once the capacity for transactional censorship is hardwired into the DFC infrastructure, it cannot be easily removed and may be used for purposes beyond the initial scope that justified its adoption.

2.7 Will DFC transactions and wallets be usable offline? How?

Discussion: While digital payments systems offer many benefits over physical cash, they suffer from vulnerabilities regarding network-connection and power consumption. In order to provide a true substitute for physical cash, some form of offline transaction capacity is crucial. Such capacity is also important in the event of network failure, and/or for actors who exist on the margins of the electric/internet grid.

2.8 Will the DFC intermediary network be an open system, or restricted to a limited number of pre-approved institutions?

Discussion: Most DFC systems, at least in the first iteration, will likely incorporate and/or rely on intermediaries to fulfill some core infrastructural functions, from wallet-management through to data-storage. Consequently, it is important for regulators to develop a framework for evaluating and approving potential intermediaries, to maintain quality and security standards while simultaneously avoiding excessive regulations that stifle innovation and widespread adoption. One way of authorizing intermediaries is to subjectively identify and approval specific applicants on an institution-by-institution basis. Another approach is to develop objective standards and criteria and approve any and all actors that meet those criteria. Determining which approach to use (or some combination) will depend on the needs and interests of the specific jurisdiction.

2.9 Will the software and hardware upon which the DFC system is based be released as open-source, or will it remain proprietary?

Discussion: As governments, central banks, and regulators evaluate different technology platforms and vendors as possible DFC system providers, it is important to consider the relative benefits open-source vs closed-source technology, in terms of cost, security, interoperability, etc. Such considerations should be informed by best practices amongst the

information technology and security communities.

2.10 Will consumer wallets be capable of self-hosting, or will they require an intermediary?

Discussion: Allowing for self-hosting of digital wallets may foster greater innovation and adoption while preserving the benefits of a decentralized payments network. At the same time, however, it raises additional security and regulatory concerns beyond those of an intermediary-based approach. Even if self-hosting wallets are not a priority in the initial design and roll-out of DFC, it is nevertheless worth considering how to design the DFC architecture to preserve such capacity as an option in the future.

2.11 What data will be gathered via the DFC platform?

- By what entities?
- How will such data be preserved and kept secure?

Discussion: DFC platforms are likely to generate a range of data beyond the transaction itself, including on the users, on the transaction, and on the broader ecosystem in which DFC transactions occur. Moreover, DFC platforms have the potential to provide a range of functions beyond basic transactions, from smart contract execution to trading platforms to innovative forms of monetary policy implementation. It is imperative that any and all such activity be conducted under a robust data protection regime with clear guidelines for different actors regarding the collection, storage and use of any data generated via the DFC system.

3 Policy & Regulation

3.1 What policy issues and considerations will be addressed via technological vs regulatory vs market-based approaches?

- What entities will be responsible for establishing technical and regulatory standards, and how will such standards be developed and subsequently enforced?
- What institutions and systems are necessary to ensure adequate dispute resolution?

Discussion: DFC technology implicates a range of jurisdictions that typically operate independently from macroeconomic policymaking to financial regulation to IT infrastructure management. Furthermore, each of these areas historically relies on different regulatory approaches – some emphasize direct supervision, others focus on encouraging industry-led standards. Determining the appropriate mix of policymaking approaches will depend on the specific needs and constraints of the jurisdiction and the proposed DFC model.

3.2 How will regulatory and enforcement coordination and harmonization be promoted between relevant actors?

Discussion: In the aftermath of the global financial crisis, financial regulators around the world have taken steps to encourage greater coordination and communication between historically silo'd regulatory agencies, in recognition of the high levels of interdependence

between different segments of the economy and financial sector. DFC implementation should build on the lessons learned from this experience, and establish a plenary, interagency network that can harmonize domestic DFC regulatory efforts between different actors from the outset. At the same time, a globally coordinated approach is necessary to coordinate regulatory efforts in specific jurisdictions, led by actors such as the Bank of International Settlements, International Monetary Fund, and International Telecommunications Union, which are already positioned at the nexus of different national and international stakeholders.

3.3 What infrastructural responsibilities will assumed by government agencies, vs outsourced to private intermediaries and vendors?

- What antitrust and competition framework will be applied to intermediary activity?

Discussion: There are a range of different ways in which DFC platforms can be managed, ranging from a public sectr-centric approach, whereby all core infrastructural functions are performed solely by government actors, to a private sector-centric approach, whereby the government recognizes standards and guidelines but otherwise delegates all crucial infrastructural-provisioning responsibility to industry actors. Choosing the right balance between these approaches will be a case-by-case determination based on the unique considerations and needs of the jurisdiction. However, to the extent that certain functions are determined to be best provided by markets it will be necessary to adopt a robust antitrust regulatory framework to ensure such markets remain diverse and competitive.

3.4 What regulations will be imposed on intermediaries performing systemically important functions within the DFC ecosystem?

- How will such regulations be enforced?
- How will regulators be trained and regulatory standards upheld?
- What budget will be allocated to law enforcement and regulation?

Discussion: Depending on the chosen implementation and management approach, a DFC ecosystem may rely upon one or more classes of private intermediaries to perform critical systemic functions, ranging from software/protocol development to data network management to wallet intermediary or consumer interface services, to banking/credit/financial product providers. Such public-private partnerships must be transparently managed and the relevant balance of power and responsibility clearly defined at the outset to minimize risk of abuse and corruption. Determining how best to do so will depend on the specific needs, goals, and capacities of the relevant jurisdiction.

3.5 What fiduciary and/or public purpose obligations will be placed on DFC wallet intermediaries?

- Are institutional intermediaries going to be restricted to money transmitter and/or narrow bank-like activity, or will they be allowed to mingle client funds with their own in a manner similar to commercial banks?

Discussion: Presently, depository institutions such as commercial banks are unique within the financial regulatory landscape in terms of their ability to mingle their own funds with those of their depositors. This capacity is often considered the 'essence' of banking, and stands in contrast to money transmitters and 'narrow banks' who are obligated to maintain a separation between their own balance sheet and those of their clients. Consequently, when designing and implementing a new DFC system, it is important to clearly establish the

fiduciary responsibilities and restrictions on DFC wallet intermediaries, and articulate how they compare and contrast to those of other existing financial intermediaries such as banks, money transmitters, and/or narrow banks.

3.6 What intermediary vendor licensing and usage restrictions will be imposed on the use of DFC technology by governments and central banks?

Discussion: To the extent that certain key infrastructural functions within the DFC ecosystem will be delegated to private intermediaries, those intermediaries will enjoy certain rights over key public infrastructure, similar to the way banks are responsible for managing retail payments systems today. In order to ensure that the government and public continue to maximize the benefits of such arrangements, it is necessary to articulate clearly at the outset the limits of private control over public infrastructure, and identify public priorities that justify regulatory intervention over private businesses. The appropriate limits will depend on the particular DFC model chosen and the unique needs and capacities of the relevant jurisdiction.

3.7 What is the legal relationship between a DFC wallet-owner, a DFC intermediary, and the DFC funds in the customer's wallet?

- How will DFC instruments be classified vis-a-vis existing forms of government and intermediary liabilities? (cash, reserves, deposits, securities, etc)

Discussion: DFC instruments do not meet the legal classification of any existing financial instrument, and indeed recent regulatory difficulties in classifying digital financial instruments suggests that historical classifications may be inadequate in fully capturing the nature and potential of new technologies. Consequently, it may be necessary to adopt a new regulatory approach for DFC that begins from a recognition of its unique features and capacities vis-a-vis existing payments systems and instruments. At the same time, however, as DFC technologies become more central to contemporary payments, it may be necessary to reevaluate existing payments technologies in light of DFC's new market structures and legal classifications.

3.8 What rules and regulations are going to be imposed on the behavior and handling of DFC funds:

- By legal classification (ie governments vs firms vs individuals etc)
- By intermediary classification (ie banks vs money transmitters vs API developers etc)
- By actor jurisdiction (ie citizens vs domestic/foreign firms vs foreign governments etc)
- By instrument (ie intermediary account, registered wallet, unregistered wallet, etc)
- By use-case (ie wholesale, retail, commercial, B2B, P2P, G2B, etc)

Discussion: Presently, there are a range of different legal and regulatory standards and restrictions that apply to management of different kinds of funds, depending on the market, actor, instrument, and purported use of funds. Many of these standards will require reevaluation in light of the potential disruption afforded by DFC, particularly as the technology becomes more widespread and its second and third-order efficiency gains begin to be realized. Due to the inherently jurisdiction-specific nature of legal and regulatory regimes,

these questions must be addressed on a case-by-case basis, even as they engage with and borrow from other jurisdiction's experiments and global best practices.

3.9 How will DFC wallets and funds be protected from fraud and tampering?

Discussion: Systemic security is maintained through both technological and regulatory infrastructure and standards, and involves a multi-layered, redundancy-based approach. While certain best practices can be adopted from existing IT and payments system infrastructure, the unique and novel aspects of DFC will necessitate new, dedicated security practices and protocols. Specific security concerns and priorities should be identified and addressed in consultation with leading experts and global best practices, but ultimately will depend on the needs and capacities of the relevant jurisdiction.

3.10 What identity and registration requirements will consumers have to comply with in order to create and maintain a DFC wallet?

Discussion: Presently, different payments systems and technologies have different identity and registration requirements, ranging from the relative anonymity of cash and pre-paid debit cards, through to the relatively strict know-your-customer requirements for depositor and central bank accounts. Given that DFC has the potential to cut across these different silo'd systems, it may be necessary to reconsider know-your-customer requirements holistically across the payments landscape rather than simply trying to fit DFC into existing regulatory categories. Such determination will ultimately depend on the specific interests and goals driving DFC adoption in the relevant jurisdiction.

3.11 What are the privacy considerations in adoption of DFC?

- How will such considerations be addressed?

Discussion: DFC systems have the potential to serve as the backbone of the entire digital payments ecosystem, incorporating not only basic transactions but also sophisticated financial market activity, smart contracts, and intragovernmental activity. As a result, policymakers must consider a diversity of privacy considerations affecting a range of stakeholders, from individual consumers through to government actors. Addressing these concerns requires consultation with appropriate experts and stakeholders beyond those already involved in DFC discussions, and may ultimately require public renegotiation of the desirable social balance between privacy and other interests. It is critical to approach these issues with sensitivity and openness in order to ensure public buy-in and support of DFC.

3.12 To what extent will wallets and/or transactions be monitorable and/or censorable?

Discussion: Regulators implementing DFC must balance concerns regarding transactional privacy and decentralization against law enforcement considerations, including those that currently govern anti-money laundering and know-your-customer standards. Individual jurisdictions seeking to address these tensions must consider not only their unique domestic context, but also the broader international law enforcement and financial regulatory regimes in which they are embedded, to ensure their preferred approach remains compliant and consistent with best practices and minimum international standards.

3.13 Will anonymous and/or pseudonymous accounts be allowed? If so, under what conditions?

Discussion: In order for DFC to truly serve as a substitute for physical cash, it should maintain some of the anonymizing and/or pseudonymizing features of bearer-instrument based transactions. Such features may be directed at the buyer-side, seller-side, or both, although the specific needs and considerations will depend on the jurisdiction.

3.14 Will there be transactional and/or balance restrictions on different kinds of wallets?

Discussion: DFC systems have the potential to handle very large transactional volumes as easily as small ones, however doing so has distinct regulatory and social implications. Consequently, policymakers should consider imposing additional regulatory requirements and restrictions on transactional activity beyond the technical layer in accordance with public purpose. This could include, for example, restricting anonymous payments to small-value consumer transactions, and/or restricting large-value real-time transactions by foreign actors. The particular needs and considerations will depend on the jurisdiction.

3.15 How will DFC-generated data be classified and regulated?

- What oversight and enforcement mechanisms will be applied to ensure data system integrity and regulatory compliance?

Discussion: Contemporary payments systems are increasingly integrated in broader media platforms and IT systems, to the extent that traditional legal distinctions between financial and non-financial data are less clear. To that extent, when considering implementation of a DFC system it is important to consider how DFC-generated data will be classified and regulated, and the appropriate scope and limits of jurisdiction of different data-regulators over core DFC or DFC-adjacent IT infrastructure. In addition, it is important to learn from and integrate best data management practices from beyond the financial sector, and maintain a forward-looking approach to data management that takes into account likely trends in industry and regulation.

3.16 How will fiscal policy practices be affected by implementation of DFC?

- How will DFC instruments be classified for purposes of public debt management?

Discussion: DFC platforms have the potential to radically simplify fiscal policy by providing an alternative mechanism for financing government spending beyond the issuance of treasury securities. However, depending on how a DFC system is set up, it may ultimately resemble or even integrate with treasury debt management practices, given the similarities between digital treasury security accounts and DFC accounts on various dimensions. In order to smoothly integrate DFC while taking full advantage of its efficiency and simplicity benefits, it may be necessary to reconsider the legal classification of government debt, its relationship to other forms of government-issued instruments (like central bank settlement balances), and the existing intergovernmental accounting framework.

3.17 How will monetary and macroprudential policy practices be affected by implementation of DFC?

- How will DFC instruments be classified for purposes of prudential and capital regulation?
- How will liquidity and credit elasticity be maintained under a DFC system?
- Under what conditions will the government provide DFC liquidity, and to whom?
- What collateral will DFC funds be lent against?

Discusssion: The introduction of DFC technology will likely require a reconfiguration of monetary policy, as existing frameworks involve careful calibration of parity dynamics between different categories of government-issues liabilities, as well their accounting treatment for regulatory and prudential management purposes. One of the most important monetary policy determinations with respect to DFC balances will be the conditions under which additional DFC balances are created, and the rates that are charged for such process. Presently, physical notes and central bank reserves are typically provided on a price-limited basis, i.e. actors can purchase unlimited quantities at set prices. By contrast, government securities are typically provided on a quantity-limited basis, i.e. only a certain quantity is issued, and the price fluctuates. If the government seeks to maintain a 1:1 parity between DFC balances and other forms of legal tender, it may be required to stand by to provide unlimited quantities in accordance with market demand, including providing DFC balances against adequate collateral in a manner similar to the discount window or overnight reverse repurchase facility does today. Conversely, if regulators wish to restrict the quantity of DFC balances, they must do so with a clear eye to the monetary policy and interest-rate implications on the broader economy.

4 Interoperability

4.1 Is the DFC system intended to replace, or complement, the existing two-tier reserve+deposit-based payments system?

Discussion: DFC technologies are diverse and can be implemented in a range of ways. For some, DFC represents an opportunity to develop a digitally-native payments system from first principles. For others, DFC is intended to merely provide a digital analog to physical cash and coins, or a superior way of delivering existing digital payments functionality. There is no single optimal way to approach or adopt DFC technology, ultimately it will depend on the specific needs and goals of the jurisdiction in question.

4.2 How will DFC platforms interact with and/or distinguish from legacy payments systems?

Discussion: Interoperability with legacy payments systems is critical to ensuring smooth adoption of new DFC technologies and realizing the efficiency gains of doing so. Some DFC systems achieve interoperability through effectively replacing or absorbing existing systems and functionalities, while other approaches seek to preserve and operate alongside existing systems through switches and bridges. Determining the optimal approach in a particular context will depend on the specific needs and capacities of the jurisdiction in question.

4.3 What interoperability requirements must wallets and wallet-managing DFC intermediaries adhere to in order to obtain and maintain their intermediary license?

Discussion: DFC systems have the potential to connect disparate payments ecosystems and financial activities through a single, common payments platform. In order to do so, however, there must be strict enforcement of interoperability requirements to ensure that transactions, wallets, and accounts can be easily transferred between different DFC intermediary providers. Such requirements can be incorporated at the level of technical standards, as well as institutional licensing conditions. More broadly, it may be necessary to explicitly cultivate public awareness of, and commitment to, interoperability to ensure it remains a key regulatory and design priority as future operational layers and features are built on top of the core DFC technology.

4.4 Under what conditions and discount rates will DFC be convertible into other forms of government and/or central bank issued liabilities?

Discussion: In addition to ensuring interoperability between payments systems and intermediaries, it is also important to consider the benefits of greater harmonization and interoperability between different forms of government-issued liabilities, from central bank reserves to government securities. Presently, the payments and trading infrastructure for government and/or central bank liabilities remains fragmented and balkanized, however under a DFC regime each of these different instruments and markets can be reconfigured as a special-purpose DFC, thereby improving overall efficiency and eliminating outdated classifications and regulatory silos.

4.5 How will DFC dispute resolution systems harmonize with existing dispute resolution systems?

Discussion: Introduction of new DFC technologies and platforms will inevitably bring with them new legal and dispute-resolution needs. At the same time, many of the anticipated issues may be adequately addressed through existing dispute-resolution systems, or will only require minor updates to such systems. Determining how best to encourage DFC-specific dispute resolution and law enforcement capacity in the context of existing infrastructure will require a context-specific analysis and strategy.

5 Implementation

5.1 What literature must be reviewed before adopting DFC?

Discussion: In recent years there has been a large increase in attention in DFC design, regulation, and adoption from various policymakers, industry representatives, and technical experts. Entities seeking to introduce DFC to their jurisdiction should conduct appropriate research and literature review before proceeding to ensure they have considered all relevant factors.

5.2 What ecosystem dynamics must be mapped and understood before adopting DFC?

Discussion: DFC technology implicates not only payments systems design, but also information technology infrastructure, jurisprudence, financial regulation, and macroeconomic policymaking. Consequently, in order to avoid unintended consequences, policymakers seeking to implement DFC must consider how doing so will impact the economy as a whole.

5.3 What are the costs and benefits, risks and opportunities of adopting DFC depending on the models and strategies adopted?

- What are the long-tail and potentially catastrophic risks associated with DFC adoption, and how will such risks be addressed?

Discussion: Due to the wide range of possible DFC models and implementation approaches, it is necessary to tailor any cost-benefit and/or risk analysis to the chosen DFC model, as well as the particular needs and constraints of the jurisdiction in question.

5.4 How should a DFC system be trialed, introduced, and monitored?

- What targets, outcomes, and success metrics are appropriate?
- What forms of data should be gathered, and how?
- What are the longer-term costs of maintenance, repair, upgrade etc that must be considered beyond pilot costs?

Discussion: Introduction of DFC technology should conform to best practices with respect to new technological adoption, public-private collaboration, and consultation with relevant experts.

5.5 What is the feasibility of adopting DFC in this particular jurisdiction on the basis of the proposals currently put forward?

Discussion: Feasibility studies should take into consideration not only the possible costs and savings of implementing DFC, but also the political and stakeholder considerations that may inhibit and/or undermine successful adoption.

5.6 What public relations strategy should be adopted to encourage success of DFC?

Discussion: Successful implementation of DFC requires consumer and industry buy-in, which in turn is shaped by marketing and exposure. To avoid the possibility of a failed rollout, similar to Ecuador's unsuccessful e-Dinero and Canada's unsuccessful Mint-Chip programs, jurisdictions seeking to implement DFC must develop a data-driven public relations strategy that draws on both global best practices and the unique needs and considerations of the relevant jurisdiction.

5.7 How should the DFC system react to and incorporate feedback and criticism?

Discussion: Adoption of DFC will implicate a range of stakeholders, from policymakers to regulators to industry to consumers to interest groups such as privacy activists. In order to ensure goodwill and buy-in from diverse stakeholders, it is important to develop reactive feedback and accountability mechanisms that recognize input from a diverse range of stakeholders.

5.8 How should a DFC project be budgeted?

Discussion: DFC projects are overwhelming led by central banks, who have unique financing capacity and budgetary independence vis-a-vis other government agencies. However, given the potentially vast scope and scale of DFC implementation, it may nevertheless be advisable to seek direct fiscal or community support for DFC projects to avoid significant budgetary pressure on an

individual actor.

5.9 What risk management concerns should be addressed prior to adoption?

Discussion: There are a range of risks to be considered prior to adoption of DFC, including those identified in this document, as well as others unique to specific jurisdictions and/or DFC models. It is important to conduct a full risk-assessment and develop a risk-management plan prior to widespread rollout of DFC technology.

6 Illustrative National Scenarios

Each individual jurisdiction is likely to face unique considerations regarding design and implementation of DFC technology, in light of its specific political context, regulatory and technological capacity, and intended features and problems to be addressed. Depending on the goals of the project, one or more of the questions identified above may be unnecessary or obsolete. For an example of how some of the above concerns might be addressed together in the pursuit of a particular vision of DFC, see the 2018 report titled *'Financial Inclusion Through Digital Financial Services and Fintech: The Case of Egypt*' by The Alliance for Financial Inclusion.

Alternatively, the following illustrative scenarios provide examples of how a jurisdiction could approach the aforementioned questions differently, depending on their context:

6.1 Scenario 1: Embracing Mobile Money

A relatively small, developing country with an advanced telecom sector and an underdeveloped banking sector experiences a surge in consumer usage of mobile minutes and/or other mobile app-based balances for basic consumer-to-consumer and consumer-to-business transactions. However, these mobile companies, in turn, rely on cash floats held at commercial banks to preserve at-part convertibility of their wallet balances into regular deposits and/or physical cash, which exposes them (and their customers) to intermediary risk in the event of bank failure.

Recognizing that the mobile money operators do not wish to obtain full banking licenses, due to the additional regulatory costs, the central bank establishes special mobile money operator licenses that allow mobile money operators to maintain accounts at the central bank, and/or enter into special trust relationships with commercial banks to ring-fence their float accounts from all other bank funds in the event of dissolution. Only authorized telecom providers may apply for such a license. Mobile money operators are also authorized to advertise savings and investment products through their mobile money app, in partnership with licensed commercial banks who offer the services and must adhere to regular prudential standards on such accounts.

In exchange, mobile money operators are required to coordinate to establish industry-driven interoperability standards to allow mobile money funds to be transferred between banks. These standards are available openly, however mobile money providers' platforms remain proprietary, subject only to standards compliance and periodic auditing by a regulatory task force comprised of experts drawn from the central bank, the payments authority, and the telecom regulatory authority. Real time settlement is achieved through a RTGS system maintained by the central bank, with accounts for both mobile money operators and commercial banks. Mobile money operators are also required to provide basic dispute resolution and charge-back services to customers, and exercise a duty of care consistent with both money transmitter and telecom provider standards, as well as engage in know-your-customer compliance at the point of account sign-ups. Anonymous pre-paid mobile phone accounts are also allowed, but transaction limits are imposed on such accounts at a maximum of $100 per day, with a maximum balance in such accounts of $500. Similarly, offline transactions can be made between mobile accounts, however offline transactions are limited to $100 per day for all accounts. Funds held in mobile wallets are considered deposit-like obligations of mobile money operators, and represent direct claims on the mobile money operator as opposed to ownership claims on the underlying central bank funds held in escrow against them. All transactional data remains the property of the telecom company, subject to existing information fiduciary requirements.

Fiscal and monetary policy remain largely unchanged, and mobile money balances are guaranteed by the government to be convertible into regular bank deposits and/or cash, with any costs incurred as a result of this guarantee imposed first on an insurance fund established by the government with compulsory regular payments by all mobile money operators in accordance with their market share. To the extent that the widespread adoption of mobile money accounts causes a drain in excess liquidity within the banking system, the central bank is responsible for mitigating that effect through active open market operations and/or expansion of overnight reverse repurchase facilities that lend funds against adequate collateral, including regular bank loan assets. At the same time, mobile money ringfenced central bank accounts do not offer interest on reserve balances, while mobile money 'float' accounts maintained with commercial bank partners do, encouraging mobile money operators to enter partnerships with banks rather than maintain direct accounts with the central bank in order to share the proceeds of higher rates paid on float balances.

6.2 Scenario 2: After the End of Cash

A country with a highly developed payments and banking system observes a noticeable decline in the usage of cash, to the point that many consumer business no longer accept cash for basic payments any longer. Recognizing the provisioning of cash services to be a core, legally mandated public service, central bank and payments regulators convene to determine how best to proactively respond to this trend. After conducting feasibility studies and reviewing global best practices literature, it is determined that the most effective and minimally invasive solution is to introduce an anonymous, small-denomination pre-paid value card that is intended to replicate the social function of cash for individual consumers.

These cards contain a maximum value of $200, and can only be purchased one-at-a-time from licensed stores using a person's state-issued ID card or passport. Purchases of pre-paid cards are recorded on a national registry to enforce the one-purchase-at-a-time rule, however the specific ID

number of each card is not recorded at the time of purchase, to preserve consumer anonymity. Patterns of unusual purchasing activity are monitored by financial regulators similar to how consumer purchases of controlled medical substances from pharmacies are monitored today, so if one individual attempts to buy multiple cards from multiple locations in a single day, it will flag that individual to the financial authorities for further review.

Each card is pre-loaded with a certain amount of nominal value representing a claim on the central bank equivalent to reserves. The cards are purchased from a pre-paid debit card vendor through a bilateral arrangement with the central bank. They do not pay interest, and cannot be recovered in the event of loss or theft. All transactions between pre-paid cards are instantaneous and irrevocable, and can be conducted offline using any bilateral payments processing devices that meets satisfies open message security and card authentication standards. Transactions from pre-paid cards to non-pre-paid cards are processed via existing retail settlement channels thanks to a special purpose intermediary account at the central bank which accepts funds from pre-paid cards and pays out to regular bank accounts, and vice-versa. Transaction data from that central bank account is anonymized and not available for inspection by financial authorities without a targeted search warrant. Balances held in pre-paid cards cannot be securitized or hypothecated, and remain solely the legal property of the bearer.

These cards are intended to serve as a functional replacement for coins and notes, and thus do not implicate fiscal or monetary policy more broadly. Existing payments regulators, and entities responsible for management of currency are responsible for monitoring and evaluating the system, and conducting periodic audits to ensure the technology is easily adopted, secure, and achieving the intended goal of serving as a substitute for physical cash.

6.3 Scenario 3: Wholesale Banking Reform

A nation with a large, sophisticated, and diverse financial sector, including deep capital markets, faces a structural undersupply of safe assets relative to demand from large, institutional investors. Historically, this demand was satisfied through a combination of government securities and risk-stripping of private near-monies, however in the aftermath of the global financial crisis, regulators determine that this approach is suboptimal, as it places additional demand on fiscal authorities to generate safe assets beyond their budgetary financing needs, and/or encourages risky and unproductive forms of financial innovation in non-bank sector in order to give the appearance of greater asset safety than such actors can structurally guarantee.

In response, the central bank decides to open up its balance sheet to non-bank financial actors through the creation of an overnight reverse repurchase facility, where actors can pledge government securities, or even private securities, at pre-determined discount rates in exchange for claims on interest-earning central bank balances. This approach is inefficient, however, as it requires intermediary dealer involvement and complicated repurchase contracts to be renegotiated on a daily basis. At the same time, the central bank is facing market competition from below, as commercial bank actors seek to exploit this unmet demand by adopting new low-risk ‘narrow bank’-style business models, whereby they make no loans, but instead merely provide a pass-through service to institutional investors, whereby they store 100% of deposited funds as reserves at

the central bank, and pay the interest earned on those reserve balances to depositors, minus an intermediary fee.

In response, the central bank decides to introduce a new product, called ‘Institutional Investor Accounts’, which are available to any financial intermediary managing client funds in excess of $50 million. These accounts function similar to reserve accounts, as digital book-entry liabilities of the central bank, and are fully interopable with legacy interbank settlement systems. These accounts come in two forms: a checking account which can be used to make payments, and which offers a rate of interest equivalent to the prevailing 3-month treasury bill rate, and a savings account which offers certificates of deposit of different durations and interest rates, equivalent to the prevailing market rates on each class of government security in circulation. There is no limit on the amount of funds that can be placed in each account. In addition, the central bank offers to buy any and all government securities for sale, at rates slightly more favorable than the rates paid on its savings accounts, to ensure that demand for treasuries at treasury auctions is not affected by its new offerings.

Together, these accounts provide the central bank with greater control over monetary policy, and satisfy market demand for safe assets without unnecessary complication or involvement from the treasury department, as competing proposals for a standing treasury facility would have done. To the extent that it causes a depositor drain from the banking system, liquidity is replenished through repurchase loans made against bank collateral and/or greater use of open market operations. The system is a RTGS system, open 24/7 and payments are settled instantly, although standard interbank and repo facility dispute resolution procedures remain in place and are extended to all participating actors. Individual investors do not own claims over the central bank balances, however institutional investors are authorized to offer ‘narrow bank’ services where they provide depositor services to retail customers against funds held in their checking account. Any such deposits, however, cannot be issued against funds held in the durational savings accounts as doing so would expose the depositor to intermediary duration risk.

This approach increases overall systemic safety by satisfying market demand for safe assets, and increases the central bank’s ability to conduct monetary policy by enhancing its control over interest rates across the yield curve. It also increases the sensitivity of monetary policy by rendering commercial banks more reliant on direct liquidity provisioning by the central bank, thereby allowing smaller interest rate adjustments to have greater demand-stabilizing effects. In addition, it promotes interoperability between depository and central bank payments layers by encouraging greater diversity of products and reducing reliance on deposit insurance as the primary vehicle for maintain at-par convertibility between digital deposit balances and government-issued currency. All accounts require standard know-your-customer and anti-money laundering compliance, and build on existing consumer-facing payments interfaces.
