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**Sovereign Digital Currencies:
Reshaping the Design of Money and
Payments Systems**

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ABSTRACT

This paper focuses on how technology might reshape payments going forward. It considers the policy issues and choices associated with crypto-currencies, stablecoins and sovereign digital currencies and emphasises that there is no single model for sovereign digital currency design. While Bitcoin and its progenies could be safely ignored by regulators, Facebook's proposal for Libra, a global stablecoin, brought an immediate and potent response from regulators globally. Any proposal by the private sector to move into the creation of currency — the traditional preserve of sovereigns — was always likely to trigger such a regulatory response, as well as the launch of sovereign digital currencies by other major central banks. While China has moved first, dozens of other countries are now investigating their own central bank digital currencies or other forms of sovereign digital currency. This paper argues that central banks should first focus not on rolling out novel new forms of sovereign digital currencies, but rather on transforming their payment systems. In time, domestic money and payment systems are expected to evolve so that central banks cooperate with (new and old) private entities to launch digital currencies that better underpin monetary and payment systems at the domestic, regional and international levels.

Keywords: *sovereign digital currencies, central bank digital currencies, Libra, digital yuan, COVID-19, payments, stablecoins, blockchain*

INTRODUCTION

In modern economic and financial systems, the state sets out the framework of the national monetary and payment system and oversees their implementation. Public entities (eg central banks) are frequently directly involved in setting up, or operating retail and large-value payment systems, in addition to being directly responsible for the issuance of currency in their central role in providing monetary stability

and payments as public goods underlying the functioning of the financial system, the economy and society more generally. Payment systems not only provide the veins for the blood of the economy to flow but also are the channel linking the other major public good supported by central banks: financial stability.

Payment systems today generally operate on the basis of intermediary-based payments with deferred net settlement, wholesale real-time gross settlement (RTGS), or 'fast' or 'instant' payment systems (FPS).¹ Two broad policy objectives dominate payment system design, namely safety and efficiency. Of the 131 countries that were reforming their national payment systems according to a World Bank survey in 2012, 113 (86 per cent) cited the need to increase overall efficiency as the factor that triggered reform.² Safety encompasses stability, integrity, and customer and data protection. Efficiency encompasses cost efficiency,³ competition and innovation.⁴ (This paper treats integrity as inherent to the safety objective and does not consider integrity in detail as a separate objective.)

Technological evolution over the past several decades is now revolutionising money and payments systems, and the ways in which these policy objectives are implemented. This technological revolution comes from both developments in centralised systems, now capable of dealing with hundreds of thousands of payments per second across millions of users, reflected in both RTGS and FPS systems. In addition, new technologies, like distributed ledger technologies (DLT) and blockchain, are offering new opportunities along with risks and challenges. Notwithstanding the immense hype around crypto-currencies, starting with the creation of Bitcoin in 2009, so far they have not grown to be real competitors, or sources of fundamental disruption, to existing systems. The announcement

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of Libra in 2019 altered the landscape dramatically.

LIBRA

In June 2019, Facebook revealed plans to roll out its own crypto-currency in 2020 — a global stablecoin called Libra.⁵ While some of the underlying technology may be different, in design terms, Libra is similar to a mobile money scheme of the kind made famous by M-Pesa in Kenya — parties buy Libra ‘coins’ for fiat currency which is in turn deposited in the ‘Libra Reserve’ such that each Libra coin is backed by deposited major fiat currency or short-term government securities denominated in such currencies.⁶

Libra is the first digital currency with the potential to become systemic — a characteristic Bitcoin and its progeny lacked. This potential scale led regulators to respond vigorously and central banks to rethink their approach to sovereign digital currencies (SDCs).⁷ In contrast to the prevailing lexicon characterised by the widespread use of the term ‘central bank digital currency’ (CBDC), this paper takes a broader view of the possible design choices of new state-run currency types. In this paper, ‘SDC’ refers to any digital form of official currency issued by or on behalf of the state that is different from traditional central bank accounts. CBDC is treated as a subcategory of SDC that is issued by a central bank.

Libra’s impact

A number of features of Libra — a combination of a crypto-currency, global electronic payment system and framework of accounts and identification — give it the potential to be particularly disruptive for payment systems and particularly sovereign fiat currencies:

- Libra’s role as an alternative payment system (APS) operated by private entities with

massive resources and scale, mean a ‘wait and see’ regulatory strategy was never likely, as Libra has the potential to become systemic virtually upon launch.

- Libra’s underlying philosophy to promote among other things, low-cost movement of money⁸ and payment networks⁹ is highly attractive and poses a major challenge to existing payment systems, characterised, as they are, by high costs and lack of access to payment infrastructure.
- Libra has forced central banks to reconsider their own monetary offerings in order to better meet the needs of the economy and financial system, and resist potential competitors, be they private, public-private or state sponsored.

Global stablecoins

The impact of Libra as the first global stablecoin (GSC) arises because of its potential for near-instantaneous scale, reach and impact. Like most forms of systemically important financial market infrastructure or systemically important financial institutions, a precise definition of this innovation can be difficult.^{10,11} The elements of a global stablecoin, however, include size, scale and interconnectiveness: basically, economies of scope and scale combined with network effects tend to suggest systemic significance in financial systems.

The first stage in dealing with GSCs is to identify them. This can be difficult in practice because offerings by non-traditional participants in finance, the so-called big techs, have the potential to scale very quickly.¹² The second stage in dealing with GSCs is to develop appropriate regulatory and supervisory tools in advance — tools that can be activated when a GSC is identified. Third, there could be a variety of approaches which could be activity, institutional or infrastructure based, depending on the nature of the specific GSC.

The key point is that the Libra experience should serve as a catalyst to develop

global systems through the Financial Stability Board (FSB) to identify GSCs, to put in place appropriate supervisory arrangements, and to monitor their activities and impact.

Libra 2.0

Reacting to the remarkably strong push-back from regulators, the parameters of Libra 2.0 were announced in a new white paper in April 2020,¹³ at which time the Libra Association (the organisation responsible for the development of the Libra project) also formally applied for supervision from the Swiss financial regulator, FINMA.¹⁴ These two events coincided with the launch of the FSB's consultation on regulatory and supervisory approaches to global stablecoins.¹⁵

Libra 2.0 dramatically scales back the original ambition of Libra 1.0 to create a global digital currency. Instead, Libra opts for a series of domestic currency stablecoins, linked in a global basket, not dissimilar in some respects from another project focused on linking, if not merging, fiat currencies and DLT environments, namely, FNLITY's Utility Settlement Coin.¹⁶

Despite the scaling back of its ambitions from Libra 1.0 to 2.0, Libra nonetheless highlighted how, for the first time, the technology, capital and scale now exist to potentially challenge the paradigm dominant since the beginning of the twentieth century that central banks issue and control currencies. Libra also pressured central banks to consider how they might use technology to build better monetary and payment systems as the foundation of economic and financial activities in order to address potential challengers while at the same time enhancing the performance of their own core objectives of monetary and financial stability, in particular through public good provision of robust monetary and payments systems.

The combination of technological developments, the expression of its possibilities in the context of Libra and the coronavirus pandemic of 2020 have together pushed forward a revolution in monetary and payment systems.

COVID-19 AND THE ADVENT OF MAJOR CURRENCY SDCS

The immediate impetus, across 2020, for governments and central banks to review and redesign existing electronic payment systems is being provided by the COVID-19 crisis, as a result of the need to efficiently and swiftly channel financial support to individuals, firms and healthcare systems, and to ensure that national payment systems are capable of dealing with the far higher levels of online and electronic payments during the crisis. COVID-19 is also being increasingly seen not only as driving immediate changes but also as providing an opportunity to improve money and payments systems going forward, in order to provide a more robust underpinning not only to weather future crises but also to better support broader sustainable development. These factors can be seen in the context of China's planned SDC launch as well as discussions in both the EU and USA. While major economy developments will have implications for the rest of the world, most countries will need to focus on their own individual contexts when considering options, with particular variations depending on levels of local monetary, payment, financial and technological development.

China's Digital Currency/Electronic Payment project

China has been researching the implications of blockchain for its monetary and payment systems including the possibility of developing an SDC since 2014. Following the announcement of Libra in

2019, related projects have accelerated. In October 2019, China announced it would launch its ‘Digital Currency/Electronic Payment’ (DCEP) project to create a ‘digital yuan’, potentially making it the first major economy to launch a central bank digital currency.¹⁷ The People’s Bank of China (PBoC) moved to live trials of the SDC in 2020.¹⁸

DCEP is shaped by China’s monetary, financial, economic and political context and aims to provide a true CBDC as well as a payment system. While many details remain unclear at this stage,¹⁹ the digital yuan will likely operate in a two-tiered system. The top level will be a network of top-tier intermediaries (TTIs) including major banks and large technology firms such as Ant (Alipay) and Tencent (WeChatPay) connected to the central bank RTGS. These entities will then, in turn, make the digital yuan available to individuals through digital wallets.²⁰ This dual nature gives the system its name — Digital Currency/Electronic Payments. The design is thus that digital yuan will become M0, eventually replacing all other monetary instruments.

The digital yuan will be a hybrid system (as this paper will elaborate in due course): the tokens issued by the PBoC to TTIs may be transferred to retail or wholesale accounts. The digital yuan will draw on a token-based DLT, operating on blockchain technology running on a centralised permissioned DLT.²¹ It is fundamentally a monetary system designed to underpin the existing electronic payment systems, including traditional bank-intermediated systems and the ecosystems of Alipay and WeChatPay, both of which are currently non-interoperable closed-loop private systems.

The digital yuan initially will not replace cash and will be interoperable with existing domestic payment systems but not foreign systems, although foreign participants in China will be able to use it.

Competition from private entities or instruments will be prohibited.²² In addition to preventing the emergence of alternatives (eg Libra) in China, it will provide much improved sources of data to the government for monitoring the economy and market integrity (especially if it eventually replaces cash) and will centralise control of the underlying monetary instrument across all payment systems.

Sweden and Canada: Developed open economies but not major financial centres

Sweden is generally accepted as leading the world in the move towards going cashless, and its central bank has produced a series of substantial reports that, if one reads between the lines, suggest that the central bank will issue a centralised CBDC before it stops printing cash. The central bank anticipates this happening by about 2023 and anticipates operating its CBDC on a centralised ledger (not with DLT or blockchain).^{23,24}

Likewise, based on a series of previous projects, in February 2020, the Bank of Canada issued a laudably clear document analysing its contingency planning for a CBDC.²⁵ This document made clear that the Bank of Canada had no plans to launch a CBDC but was building capacity to do so, if it became necessary. The Bank of Canada envisaged two scenarios in which such a need could arise.

The first scenario is if Canada moves to being a cashless society.²⁶ Should the move away from cash necessitate Canada issuing a CBDC, its February 2020 report envisages that this would be ‘cash-like’, ie ‘earn no interest and be universally accessible’.²⁷ It also envisages that it would offer a ‘great deal of privacy’²⁸ but not anonymity. The usage of cash in Canada has been in decline, as it has in most major economies. By 2017, only 33 per cent of transactions at

the point of sale (and only 15 per cent by value) were completed using cash, down from about 54 per cent in 2009.²⁹ This compares with cash being used in some 37 per cent of transactions in Australia,³⁰ and only 15 per cent of transactions in Sweden in 2016.³¹

The second scenario would arise if Canada's monetary sovereignty is threatened by 'a private/digital currency not denominated in Canadian dollars'.³² This is an obvious reference to Libra 1.0 or some similar initiative becoming operative.

The Bank of Canada's report is interesting in that it focuses very much on the loss of monetary sovereignty, whereas the reports of the Sverige Riksbank consider the loss of monetary sovereignty but are more concerned about how having only commercially provided payment mechanisms will impact on the poor and those living in remote areas.

The experience of these two countries is likely to be the most relevant in the context of countries with well-developed existing financial systems, particularly those faced with the challenges associated with reducing dependence on cash.

Singapore, Hong Kong SAR and the UK: Major international financial centres

The approaches of the UK, Singapore and Hong Kong SAR will also be watched closely given their leading roles as financial centres, particularly for FinTech and RegTech. All three have carefully focused on their positions and the role that CBDCs — particularly in the wholesale and trade contexts — could have going forward.

These jurisdictions are particularly focused on their potential to be intermediaries, and how to be a node between major digital currencies going forward. This issue is clearly central to Hong Kong's future as it could emerge as the major point of

exchange for transactions between the digital yuan area and the rest of the world.³³

The digital euro

A Eurosystem Task Force is currently considering the merits of issuing a digital euro. Its 'Report on a Digital Euro'³⁴ published in October 2020 (the 'Report') is intended as the starting point for broader discussion and sets out how the European Central Bank (ECB) intends to consider possible approaches to issuing a CBDC for Europe based on three critical elements. First, a digital euro must comply with the Eurosystem's core principles, mandates and policies. Secondly, the Report considers the scenario-driven prerequisites necessary to balance the issuance of a digital euro with the needs of users and the Eurosystem's core principles and aims. Finally, a set of general requirements is identified with the purpose of ensuring that the EU economy is protected against any risks arising from the issuance of a digital euro.

The Report also considers the possible functional designs, technical and organisational approaches to a digital euro in line with the scenario-driven prerequisites and general requirements set out above. While this discussion does not provide any concrete decisions for the basic design features of a digital euro, it does set out the initial thoughts of the ECB. Overall, restricted usage through synchronised functionality offline (physical devices such as smart cards) and online (web-based services) provided through supervised intermediaries seems plausible. The ECB is of the view that offering offline private payments could possibly provide the EU with a competitive edge in line with services provided by wallet providers and stablecoin issuers. Whether an account-based or bearer instrument is preferable depends on the choice of underlying back-end infrastructure.

The High-Level Task Force on CBDC will supervise the practical experimentation with the aim of deciding whether to introduce a digital euro by mid-2021, to be followed possibly by an investigation phase.

The digital dollar

The ‘digital dollar’ proposal was included in the US legislative package of responses to the COVID-19 crisis in March 2020, which includes both monetary and payment elements. It is unlike the digital yuan as it includes both a digital token (which could be used in both wholesale and retail transactions) and a universal account-based payment system in which each person would have their own account with the Federal Reserve. It would thus enable rapid delivery of financial resources across the economy and technologically enable a very wide range of interventions from the central bank.

A digital dollar is certainly possible. The most likely solution would be a hybrid involving the public and private sector — a stablecoin partnering a private consortium with the central bank or synthetic CBDC (where a private stablecoin has direct access to fiat currency and/or liquidity from the central bank).

In the absence of a digital dollar, the digital yuan, once eventually allowed offshore,³⁵ will potentially undercut the dominant role of the US dollar in the denomination of international trade such that it will threaten the many major benefits the USA currently receives from minting the world’s global reserve currency.³⁶ For this reason alone, it is very difficult to see the USA not launching a digital dollar as a defensive measure, should the prospect of the digital yuan being approved for use outside China become imminent.

The Bahamian sand dollar

The digital Bahamian currency, referred to as the sand dollar,³⁷ was launched on 20th

October, 2020 as the world’s first national CBDC, following successful pilot projects in the Exuma and Abaco regions.³⁸

The Central Bank of the Bahamas announced that the first phase of the national rollout would focus on the sand dollar’s preparedness for use in the private sector via a network of authorised financial institutions (AFIs) providing services to retail clients.³⁹ Opening personal accounts, in the form of low-value digital wallets, to access these services would be subject to know-your-customer (KYC) requirements with transaction limit restrictions. Business accounts would be subjected to stricter KYC requirements with higher transaction limits. The second phase of the national rollout is intended to focus on engagement with government and public utility services.

Sand dollar AFIs are required to undergo a cyber security evaluation prior to being able to incorporate the sand platform into their own bespoke applications. The sand dollar digital wallets themselves incorporate multi-factored authorisation and data encryption functionality. To ensure regulatory compliance and governance risk management checks, each transaction is integrated into a platform that provides for anti-money laundering (AML) systems and measures for countering the financing of terrorism (CFT).

Overall, the launch of the sand dollar forms part of the government’s broader financial inclusion strategy to increase financial literacy and access to payment services across the archipelago with the aim of driving down delivery costs, increasing efficiency and promoting financial inclusion overall.⁴⁰

REDESIGNING MONEY AND PAYMENTS

Technological evolution is combining with geopolitics and the COVID-19 crisis to drive new thinking and approaches

to money and payments. In looking at the potential to design better money and payments systems, design choices must be based on the specific circumstances of individual economic and financial systems rather than on any single model or technology. This section sets out a SDC taxonomy and discusses the opportunities and challenges that come with SDCs more generally, with a particular focus on design choices relating to CBDCs.

SDC taxonomy

As discussed below, SDC projects typically differ across four major design parameters: users, architecture, technology and scope.

Users

The range of potential users is very broad. Some SDC projects include TTIs only, some include all intermediaries (TTIs and non-TTI PSPs), while others seek to include all wholesale or even all retail transactions. At first sight, opening SDCs for all (retail and wholesale) users seems a major leap. But central banks do have a long history of opening direct accounts for non-financial institutions and individuals.⁴¹ For example, the Bank of England allowed members of the public to open accounts from its founding until well into the 20th century, and continued this for employees up to 2016,⁴² as did the Bank of Amsterdam.⁴³ In addition, some central banks offer direct accounts for governmental agencies.⁴⁴

As with any settlement system, however, the efficiency of central bank access for non-banks and individuals depends on demand: disintermediation is only achievable when both parties to a payment transaction have an account with the central bank. This is ensured where *all* transactions are settled with the central bank. At the same time, partial central bank access could be less efficient than the current TTI

oligopoly, which leads to the second question: the choice of architecture.

Architecture

This paper distinguishes between three different kinds of SDC:⁴⁵

- *Centralised SDCs*: In essence, each user has an account with the central bank where their units of value are stored and available for all transactions. Such a design is necessarily account-based, which means verification is required to access and spend the currency based on the identity of the currency owner, similar to identification of bank account holders.⁴⁶ It essentially resembles so-called 'electronic money' systems that are based on exchange of official currency for a matching balance (generally at par value) with the issuer (such as a telecoms operator).⁴⁷ By design,⁴⁸ centralised SDCs are permissioned systems and lack cash-like qualities,⁴⁹ in particular anonymous exchange.⁵⁰
- *Decentralised SDCs*: A decentralised SDC bears the closest resemblance to Bitcoin and other decentralised digital APS. One such concept, Fedcoin,⁵¹ is, at its core, a variation of the Bitcoin protocol that nonetheless enjoys a guaranteed exchange rate into the official currency (USD). In this system, mining is still required to produce a record of transactions, but alternative consensus algorithms can be implemented. Crucially, a truly decentralised SDC offers cash-like features and does not necessarily require identification and KYC checks for each user. Technically, full decentralisation is achievable through tokenisation.
- *Hybrid SDCs*: A hybrid SDC is a blend of a centralised and decentralised SDC. While it may use central bank accounts, not all users need to have such an account: intermediaries link the users to the central bank, while each of the intermediaries runs its own DLT-based system. There are many design options. One such proposal involves

several levels of interoperable blockchains, the first one operated by authorised (private) payment system operators (which produce blocks that may reference not only their own previous blocks but also each other's previous blocks — thus creating a cross-referenced chain), the second maintained by the central bank that produces the 'main blockchain' containing the authoritative record of transactions.⁵² Within each distributed ledger, tokenisation may lead to cash-like characteristics such as anonymity. If each of the distributed ledgers is an enclosed system, AML/KYC checks can be performed at the initial stage. The risk of intermediary default can be mitigated by legal means, for instance by appointing the intermediary as the central bank's agent, turning all tokens substantively into drawing rights on the funds stored in the central bank accounts.

Many recent SDC proposals suggest an intermediated approach where central banks provide access to central bank accounts through qualified counterparties.⁵³ These operators would be prohibited from lending or taking on any new risks on client funds. In addition, a multiplicity of operators would create competition and reduce the administrative burden and operational risks on central banks and avoid their needing to deal with millions (and perhaps even a billion) accounts simultaneously.⁵⁴ Alternatively, in Ketterer and Andrade's model, private firms 'provide all the transactional and customer services related to CBM [central bank money] accounts', while maintaining a 100 per cent reserve for each deposit at all times.⁵⁵

Intermediation of central bank accounts can take various forms, from new types of commercial bank accounts, to accounts with (non-bank) trusted intermediaries fully guaranteed by the central bank. In each case, however, users of the new currency should have direct recourse to central bank

accounts. This would require introducing the technology while preserving the current TTIs' oligopoly of central bank deposits and at the same time ensuring the corresponding benefits to end users (in particular, insolvency remoteness).

Technology

Technology remains an evolving choice, with some systems centralised using traditional payments processing technologies (eg RTGS, FPS) and others based on DLT/blockchain (albeit so far centralised permissioned systems rather than decentralised permissionless structures), an issue revisited below.

Scope

The system may extend only to monetary arrangements or to payment arrangements or it may include elements of both. This issue is also revisited below.

Benefits, opportunities and challenges

Benefits and opportunities

An SDC is often an attempt to marry the benefits of APS and central bank money. The dream is to ensure universal acceptance within the formal payment system while eliminating, or greatly reducing the role of, costly middlemen.⁵⁶ Such a design would bring a number of benefits, including:

- central banks could act as the ultimate trusted, bankruptcy-proof intermediary, replacing commercial banks and use SDC as a vehicle for critical national expenditure to bypass commercial banks completely, potentially reducing systemic risks associated with commercial banks;
- central banks and governments could modernise their ageing wholesale payment systems with advanced functionality including support for smart contracts (the idea of 'programmable money');⁵⁷ and

- SDCs could also be used for raising money by the state — a feature of Venezuela's Petro,⁵⁸ an asset-backed crypto-currency which was designed to supplement Venezuela's ailing economy, raise capital and attract investment by circumventing US sanctions — this feature remains possible, although Petro did fail for other reasons.

Challenges

Regulatory challenges relating to SDCs include:

- technical issues involved in setting up an SDC, particularly in the absence of accepted international standards on DLT and blockchain — regulators are faced with a multitude of possible design choices, yet may have inadequate resources or limited access to the required expertise to answer the many technical questions required;
- concerns about the impact of SDCs on the payment system, financial markets and economy:
 - regulators should perform a comprehensive *ex ante* analysis of the system, identifying entities that may end up in direct competition with the state once it implements an SDC (eg commercial banks, electronic money issuers);
 - alternatively, regulators may seek to level the playing field by artificially making SDCs less attractive by placing limits on interest or other features (at least initially);
 - regulators must also consider implications for money supply and whether the new currency will be issued via an initial coin offering or in exchange for other forms of sovereign money (eg cash) or commercial bank money (or both) and design corresponding conversion mechanisms; and
- legal issues around the need to introduce the concept of SDC into the national regulatory system will need to be resolved.

This may, in turn, alter the existing approach to the regulation of non-sovereign crypto-currencies. In particular, many central banks still lack full authority to regulate and supervise payments systems and providers and many central bank laws also limit the forms in which currency may be issued (eg notes and coins).⁵⁹

Technology: Departure from DLT

An oft-discussed aspect of CBDCs is technology.⁶⁰ Although the examination of the option of issuing an SDC may flow from consideration of the opportunities offered by the technologies underlying Bitcoin against the recurring challenges facing payment systems, implemented SDCs may well use neither DLT nor blockchain. In the words of a recent Bank of England discussion paper, 'although CBDC is often associated with distributed ledger technology (DLT), we do not presume any CBDC must be built using DLT, and there is no inherent reason it could not be built using more conventional centralised technology'.⁶¹ Further, according to a 2020 report from the Bank for International Settlements (BIS), only five out of 17 general access SDC projects focus on using DLT.⁶²

Fully decentralised systems would need to use permissionless DLTs (most likely with blockchain), while the more likely centralised and hybrid SDCs would use permissioned DLT if they use DLT at all. In terms of issuance control, the system is likely to be centralised. Yet DLT often suffers from performance, data protection/privacy, liability and other difficulties. Systems designers seem to prefer DLT for token-based systems, while account-based systems mostly rely on conventional infrastructure.⁶³

Further design choices made more difficult to address by a DLT environment relate to cyber security, the rectification of mistakes/erroneous payments and user identification. In light of all these factors,

most SDCs are unlikely to use DLT or blockchain.⁶⁴

Central bank access: Efficiency vs financial inclusion

The four major design parameters of users, architecture, technology and scope lie at the heart of a CBDC and interrelate: if user groups are strictly limited, efficiency can be the guiding rationale. This is because most TTIs, as large financial intermediaries, can withstand short-term shocks and periods of non-operation. If absolutely necessary, TTIs can refinance themselves in the capital markets and discuss compensation with the central banks. All this can occur internally without threatening public trust.

But the same is not true for most retail and many wholesale users — any service interruption would immediately erode trust in the financial system. The more user groups in a system, the more the focus of necessity shifts from efficiency to safety. Given that intermediation isolates some operational risk in the organisation of one intermediary, where central banks follow the safety paradigm, a hybrid (semi-decentralised) model is most likely.

For developing countries, however, the main concern will be creating an inclusive infrastructure — a stable system that includes, in particular, rural residents and the poor.⁶⁵ Here, full disintermediation may be favoured as intermediary-based coverage may not currently exist. However, a developing country choice in favour of a centralised SDC may only be temporary. Once additional services are provided by the private sector, the respective central banks may return to a hybrid SDC model with gradually receding optional central bank access replaced by the private sector.

Another factor involves the operational resilience of the issuing central bank: if a central bank is reliable, tech-savvy and capable, and seeks to enhance financial inclusion,

a centralised architecture will probably be more suitable, and where it is unreliable or unable to operate retail accounts well, a decentralised architecture will, in principle, be advisable.

From this design choice will follow who has access: where efficiency is paramount, access will be limited to TTIs; where financial inclusion matters most, central banks may prefer retail access.

Towards public-private partnerships

Within this framework, three dominant alternative approaches may be envisaged: (1) central bank accounts with general access; (2) central bank accounts with intermediated access; and (3) new digital forms of fiat currency.⁶⁶

Within these three approaches, a fully disintermediated SDC, while conceivable in theory and desirable from a financial inclusion perspective, is unlikely to be maintained by central banks in the long run. With a fully disintermediated architecture, operational malfunctions of the system (for instance, in the event of a cyber attack or a deficient software update) will impact directly on the economy, without intermediaries diversifying the risk and partially mitigating its impact. There is little evidence central banks could handle day-to-day operations with millions of retail clients efficiently — and even less evidence to suggest they have any appetite to do so. Central banks tend to lack both the infrastructure and expertise for such a role. Full disintermediation would require central banks to significantly enhance their operational capacities,⁶⁷ entering, *inter alia*, into (1) credit scoring, (2) AML/KYC checks, (3) rebooking of erroneous transactions, and (4) building large-scale retail infrastructure equivalent to automated teller machines and payment terminals for SDCs. At the same time, ‘monobank’ structures in centrally planned systems

have never been known for their efficiency although technological advances may be altering this.⁶⁸

Finally, while SDC mining and destruction could be monopolised in the hands of the central bank to ensure monetary stability, a truly decentralised SDC would likely come with reduced enforcement of KYC/AML standards and reduced information flow to the respective central bank.

For these reasons, central banks and regulators will most likely collaborate with commercial banks, payment systems operators, TechFins and FinTechs to utilise their existing infrastructure. Successful CBDCs will most likely be public–private partnerships (PPPs), with the central banks providing the definitions, interfaces and accounts and the private sector offering the applications and operational interface to service mass clients.

Such systems will most likely be complemented by a range of CBDCs, in many cases combined with new forms of fast payment systems, potentially eliminating traditional intermediated structures in some cases, and being operated by them in others. Hence, the most likely outcome is a mix of central bank accounts with intermediated access and new digital forms of fiat currency.

Regardless of the benefits, a PPP may also come with downsides: partnership with private entities may require more information-sharing with the private sector (as the latter needs to build interfaces); and if proprietary information needs to be shared this could offset the beneficial effect created by the additional resources available to private entities.

Money versus payment?

A real opportunity in particular exists to address the separation between transactions (such as securities or derivatives transactions) and payment for those transactions, particularly at the wholesale level.⁶⁹ Rather

than issuing an SDC, a central bank might allow the creation of a stablecoin, backed by deposits of fiat currency with the central bank — something the International Monetary Fund has called a ‘synthetic stablecoin’.⁷⁰ A synthetic stablecoin could effectively serve as sovereign currency in specific DLT-based systems⁷¹ — even where the rest of the monetary system is not using DLT.

Fundamentally, regulators must determine whether they want to build a monetary or a payment system. The word ‘currency’ implies building the former. However, this is only achievable if the SDC is designed to substitute for (or replace) cash, that is, with anonymous transactions (although it is almost certain that many will in fact collect a variety of information for central banks and other authorities) and payment finality. As this paper has shown, both the decentralised and the hybrid SDC models are able to have these features. If these features are implemented, the distinction between payment and monetary system — previously so important due to credit, transactional and operational risk — ceases to exist.

It is likely that the hybrid model will prove to be the most widely adopted but that the greatest benefit in many cases may come not from a digital monetary instrument alone but rather from a merger of monetary and payment arrangements as highlighted in the context of the digital dollar. A DCEP approach is likely to be the most effective where comprehensive electronic payment arrangements (such as in China or the EU) currently exist. In jurisdictions where there are substantial numbers of people without access to accounts (including the USA, UK and most developing countries), a centralised account structure (albeit providing minimal services) may well prove more efficacious.

CONCLUSION

The catalysts of technological development, its expression in Libra, COVID-19

and the increasingly likely implementation of one or more major currency CBDCs are driving the necessity of a new approach not only to payments systems but also monetary systems.

Looking forward, the advent of one or more major currency CBDCs will trigger the necessity of addressing questions not only of competition but also of external use and interoperability. If and when the digital yuan fully launches, it will most likely be the first major-currency CBDC. Its full launch across China will likely trigger the activation, acceleration or development of a number of similar projects around the world.

The digital yuan should provide a means of controlling currency inflows and outflows into the RMB area, initially mainland China. One intention is that it will be gradually opened to foreign participation, albeit not necessarily to use outside of China's internet and blockchain environment. In time, its geographic reach could well be expanded, so as to serve as a potential dollar alternative outside the reach of the USA but fully under the oversight of China. Once opened to foreign use, it will provide a potential means of internationalising the RMB — a stated major goal of China since the 2008 global financial crisis, albeit one that has been dramatically slowed since China's financial turmoil of 2015.⁷²

The expected eventual launch of China's SDC is having a similar catalytic effect as Libra, with COVID-19 putting further pressure on central banks around the world to increase their own developmental efforts. In addition, the launch of a major currency SDC will force countries around the world to consider carefully how they will build systems to interact. Likewise, the development of one major currency SDC is forcing other major currency issuers to consider the implications from the standpoint of the competitiveness of their own offerings, with a dramatic increase in discussions around a

possible digital dollar and digital euro. The technological revolution in money and payments is thus now moving from theoretical to real, and monetary and payments professionals will increasingly have to grapple with related issues, not just when looking for opportunities to improve their own systems but also when interacting with the new systems being created, particularly those emanating from the major economies and major currency issuers.

As this paper has shown, there is no single model for SDCs, and the key parameters of design choices are, in fact, largely determined by the efficiency versus safety paradigm that shapes most central banks' and regulators' decisions. Ultimately, highly robust and efficient digital monetary and payment systems will most likely be neither fully 'public' nor fully 'private', but rather arise from public-private partnerships.

AUTHOR'S NOTE

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