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SOVEREIGN DIGITAL CURRENCIES: THE FUTURE OF MONEY AND PAYMENTS?

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Abstract: Technology is reshaping money and payment systems in unprecedented ways. Catalysts include the launch of Bitcoin in 2009, the evolution of both decentralised and centralised technologies, the announcement of Libra in 2019, live trials of China's Digital Yuan, and COVID-19, both in 2020.

This paper focusses on how technology might reshape money and payments going forward. It considers the policy issues and choices associated with cryptocurrencies, stablecoins and sovereign digital currencies and emphasises there is no single model for sovereign digital currency design. The catalysts reshaping monetary and payment systems challenge regulators. While Bitcoin and its thousands of progenies could be ignored safely by regulators, Facebook's proposal for Libra, a global stablecoin, brought an immediate and potent response from regulators globally. This proposal by the private sector to move into the traditional preserve of sovereigns – the creation of currency – was always likely to trigger such a regulatory response and also the launch of sovereign digital currencies by central banks. China has moved first with its Digital Yuan – an initiative that may well in time provoke a chain of central bank digital currency issuances around the globe.

COVID-19 is driving digitalisation to new heights, particularly in electronic payments. In this context, we argue that central banks should focus not on rolling out novel new forms of sovereign digital currencies, but rather on transforming their payment systems. Further into the future, we expect domestic money and payment systems to involve public central banks cooperating with (new and old) private entities to launch digital currencies which underpin better monetary and payment systems at the domestic and international levels.

Keywords: Sovereign digital currencies, central bank digital currencies, Libra, Digital Yuan, COVID-19, payments, blockchain, distributed ledger technology, mobile money, e-money, fast payment systems, real time gross settlement systems.

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I. INTRODUCTION

At the core of all modern economic and financial systems are monetary and payment systems, with a central bank generally responsible for maintaining monetary stability and financial stability as public goods underpinning wider economic, social and developmental objectives.¹ Historically, the state has played the key role of authorising certain media of exchange as national currency and promoting demand for such media of exchange by requiring that certain payment obligations (e.g. taxes, duties and levies) be satisfied exclusively through its use. Payment systems – situated centrally in monetary and financial systems – form the key linkage between the economic and financial systems, with the availability of dependable and efficient means of payment likewise being a public good, supporting monetary and financial stability.

In contemporary economic and financial systems, the state sets out the framework of the national payment system and oversees its implementation. Public entities (e.g. central banks) are frequently directly involved in setting up, or operating, retail and large value payment systems. Payment systems today generally operate on the basis of one of intermediary-based payments with deferred net settlement, wholesale real-time gross settlement (RTGS), or ‘fast’ or ‘instant’ payment systems.²

Two broad policy objectives dominate payment system design: (i) safety; and (ii) efficiency.³ Safety encompasses stability, integrity,⁴ and customer and data protection. Efficiency encompasses cost efficiency,⁵ competition and innovation.⁶

Developments in both existing centralised technologies as well as new technologies, like distributed ledger technologies (DLT) and blockchain, offer new ways to assist with achievement of these policy objectives. Yet, while these technologies have attracted the attention of regulators, with the exception of mobile payments (largely based on centralised systems to date) they have not so far substantially disrupted the money and payments landscape. Notwithstanding the immense hype around cryptocurrencies, they never grew to be real competitors, or sources of fundamental disruption, to existing systems. This all changed with the announcement of Libra in 2019.

II. LIBRA AS A SYSTEMIC CATALYST

In June 2019 Facebook revealed plans to roll out in 2020 its own cryptocurrency – a global stablecoin called Libra.⁷ In design terms, Libra is basically 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. Libra in turn provides the monetary instruments across a range of payment systems (in particular those of Facebook: Facebook, WhatsApp, and Instagram Pay), linked via digital identification systems of Facebook and others.

In terms of monetary history and the role of technology, the announcement of Libra will be a key date, regardless of whether it ever actually comes into existence. Libra was a potent catalyst, not

due to some profound design innovation, but because of its extraordinary global reach – one-third of humanity regularly uses their Facebook account. 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).⁸

A. *Libra's Impact on the Future of Monetary and Payment Systems*

A number of features of Libra give it the potential to be particularly disruptive for payment systems and SDC projects. These features are as follows:

- (i) 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, since Libra has the potential to become systemic virtually upon launch. The impact of Libra could move from being too-small-to-care to too-large-to-ignore to potentially too-big-to-fail within months.⁹
- (ii) Libra can generate a broad spectrum of risks for consumers and payment systems that demand a regulatory response including: (a) undermining competition in the payment services market (if the platform is non-interoperable); (b) weakening the effect of monetary policy measures; (c) increasing global demand for assets within the Libra Reserve; and (d) jeopardising global or regional financial stability (as disruption of Libra could affect many economies at once).¹⁰
- (iii) Libra raises other risks, including, among others¹¹ (a) legal uncertainty, due to unclear legal status of Libra under national laws; (b) lack of sound governance, as Libra's own value is based on the value of underlying assets (which form the Libra Reserve) and depends on the efficiency of the corresponding stability mechanism; and (c) failure to ensure operational resilience of a large-scale currency platform.
- (iv) Libra represents an evolution of some ideas underlying Bitcoin and can be used by governments as a litmus test of new technologies. Libra developed their own proof of work model (known as 'LibraBFT') promising 'high transaction throughput, low latency, and a more energy-efficient approach to consensus'.¹² Other notable innovations include a new custom programming language¹³ and a revised blockchain structure.¹⁴
- (v) Libra may conflict with certain SDC projects, in particular with respect to the increased demand for government securities from both central banks (which require sufficient assets to issue new liabilities in the form of SDC) and from the Libra Association (which intends to use such securities to back the value of Libra);¹⁵
- (vi) Libra's underlying philosophy – expressed in the Libra 1.0 whitepaper as being to promote "global, open, instant, and low-cost movement of money"¹⁶, and, in the Libra 2.0 whitepaper, as the establishment of "global, open, instant, and low-cost *payment*

networks”)¹⁷ – is highly attractive. This very attractiveness poses a major challenge to existing payment systems, characterised, as they are, by high costs and lack of access to payment infrastructure.

- (vii) Libra’s global nature forces governments to rethink their cooperation arrangements. Ad-hoc working groups and coordination through the G7/G20, FSB and BIS will not suffice for day-to-day-supervision of a global monetary and payment system, and supervisory colleges do not exist for all types of financial services provided by Libra.
- (viii) Most significantly, from our standpoint, 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.

B. Libra as a Global Stablecoin

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 (FMI) or systemically important financial institutions (SIFIs), precise definition of a GSC can be difficult.¹⁸ The elements of a GSC, 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 BigTechs, have the potential to scale very quickly. 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. Activity-based approaches will vary depending on the nature of the products and services offered, and whether the GSC is to be used for monetary, payments or securities settlement services. Cooperation and coordination on licensing, market access, supervision and resolution will all be required.

The key point is that the Libra experience should serve as a catalyst to develop global systems through the G20, Financial Stability Board (FSB) and others to identify GSCs, to put in place appropriate supervisory arrangements, and to monitor their activities and impact.

C. Global Stablecoins Constrained: The FSB and Libra 2.0

Reacting to the remarkably strong pushback from regulators, the parameters of Libra 2.0 were announced in a new whitepaper in April 2020,¹⁹ at which time Libra also formally applied for supervision by the Swiss financial regulator, FINMA.²⁰ These two events coincided with the launch of the FSB’s consultation on regulatory and supervisory approaches to global stablecoins²¹ culminating in a final report and high-level recommendations published in October 2020.²² The

high-level recommendations are intended to engender a coordinated approach to the regulation, supervision and oversight of privately-issued global stablecoin arrangements in an effort to address its risk to financial stability, while at the same time promoting responsible innovation. The high-level recommendations to governmental authorities include, amongst others:

- (I) utilising necessary powers and resources to regulate, supervise and oversee global stablecoin arrangements;
- (II) applying regulatory, supervisory and oversight requirements on a functional basis proportionate to potential risks;
- (III) coordinating with authorities domestically and abroad to develop consultation and communication; and
- (IV) applying a governance framework setting out accountability for functions and activities.

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, FNALITY's Utility Settlement Coin.²³

Libra highlighted how, for the first time, the technology, capital and scale now exist to potentially challenge the dominant paradigm that central banks issue and control currencies. Libra also prompted central banks to consider how they might use technology to build better monetary and payment systems as the foundation of economic and financial activities.

The announcement of Libra was followed by a dramatic scaling up, around the world, of work on SDCs – both ongoing and new. The highest profile announcement came from China's central bank, the People's Bank of China, in late 2019, taking the lead by announcing its intention to launch its own central bank digital currency.²⁴

III. THE DIGITAL YUAN AS A SYSTEMIC CATALYST²⁵

In October 2019, China announced it would launch its 'Digital Currency / Electronic Payment' (DCEP) project to create a 'Digital Yuan', making it the first major economy to launch a central bank digital currency. The proposed creation of a private 'global stablecoin' such as Libra by a foreign company was always likely to trigger the precise response seen from China.²⁶

China had been researching and developing a Digital Yuan since 2014. The People's Bank of China (PBoC) was thus well placed to move swiftly to live trials of the SDC.²⁷ We suggest that China's Digital Yuan will prove to be *the* powerful disruption that kickstarts a move from the extensive SDC-related research and piloting we have seen in Canada, England and elsewhere, to multiple instances of SDC *issuance*, particularly by major economies.

A. Design Choices

The Digital Yuan is shaped by China's monetary, financial, economic and political context and aims to provide a true central bank digital currency (CBDC) as well as a payment system. 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 Alibaba/Ant and Tencent connected to central banks in RTGS. These entities will then, in turn, make the digital yuan available to individuals through digital wallets.²⁸ This dual nature gives the system its name of DC/EP: digital currency / electronic payments.

The Digital Yuan will be a hybrid system (as elaborated upon below in section VI): the tokens issued by the PBoC to TTIs can then be transferred to retail or wholesale accounts. It will draw on a token-based DLT, operating on blockchain technology running on a centralised permissioned DLT.²⁹ 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 will be prohibited.³⁰ In addition to preventing the emergence of alternatives (e.g. 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.

The Digital Yuan should provide a means of controlling currency inflows and outflows into the RMB area, initially Mainland China. In time its geographic reach could well be expanded, especially on the back of the Belt and Road Initiative and to countries involved in that initiative, so as to serve as a potential dollar alternative outside the reach of the US but fully under the oversight of China. Such a fundamental reconfiguration of the global monetary system would have far reaching consequences – denying the US some of the 'exorbitant privilege' it currently receives from minting the world's principal global reserve currency and denying the US the capacity to impose financial sanctions on foreign countries.³¹ As we will see below, similar motivations underlie related discussions in other jurisdictions.

B. First Mover among Global Major-currency CBDCs: The Geopolitics of CBDCs

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 intention is that it will be gradually opened to foreign participation, albeit not necessarily to use outside of China's internet and blockchain environment. Once opened to foreign use, it will be a means of internationalising the Yuan – 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 2015.³²

At the same time, the Digital Yuan will have the potential to displace other currencies in international transactions involving China, weakening the role of the US dollar in cross-border

transactions involving China. This is likely as the Digital Yuan, as a blockchain-based digital currency, should interact particularly well with the smart contracts and other digital initiatives designed to dematerialise the paperwork currently involved in international trade. Once the Digital Yuan is enabled for use in foreign trade transactions, much trade with China will likely (for reasons of efficiency and convenience) be denominated in it – resulting in the growth of the global importance of the Yuan and much valuable information about each trade ending up in China, not the trading partner’s country. For this reason, at this stage, major central banks around the world will most likely respond with their own CBDCs.

While the full launch of the Digital Yuan will accelerate major country CBDC efforts – it is the COVID-19 crisis that is forcing central banks and governments around the world to consider urgently whether they can and should develop and implement their own CBDCs, in a variety of forms.³³

And, in fact, this is also the case with China. While the plan to launch the DC/EP was announced only months after the announcement of Libra in mid-2019, its actual launch was delayed, despite the technical arrangements being in place, until the COVID-19 crisis provided the final catalyst for China to take the ultimate step of initiating the next step forward towards the utter transformation of its domestic monetary and payment system.³⁴

IV. COVID-19 AS A SYSTEMIC CATALYST

The first two systemic catalysts examined in this paper – Libra and the Digital Yuan – challenge money and payment systems, policy makers and regulators around the globe, and give rise to different levels of disruption. However, the immediate impetus, right now, 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 in the crisis.

In this regard, it is interesting to compare the approaches of developed economies to CBDCs, with those of Canada, Sweden, the UK and Singapore particularly relevant, in addition to those of the other major international currencies: discussions for a ‘Digital Euro’ in the EU and US proposals for and discussions of a ‘Digital Dollar’.

A. Canada and Sweden: Developed Open Economies

Canada’s and Sweden’s preparations to issue CBDCs are among the most advanced of the developed economies.

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, imply clearly 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).³⁵

In the case of Canada, following project studies, and involving some cooperation with the Bank of England, in February 2020, the Bank of Canada issued a laudably clear document analysing its contingency planning for a CBDC.³⁶ 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 is moving to being a cashless society.³⁷ Should the move away from cash necessitate Canada issuing a CBDC, its February 2020 report envisages that this would be ‘cash-like’, i.e. ‘earn no interest and be universally accessible’.³⁸ It also envisages that it would offer a ‘great deal of privacy’³⁹ 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 2009.⁴⁰ This compares with cash being used in some 37 per cent of transactions in Australia and only 10 per cent of transactions in Sweden in 2016.⁴¹

The second scenario would arise if Canada’s monetary sovereignty is threatened by ‘a private / digital currency not denominated in Canadian dollars’.⁴² 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 focusses very much on the loss of monetary sovereignty whereas the reports of the Sverige Riksbank in Sweden consider the loss of monetary sovereignty but are more concerned about the impacts on the poor and those living remotely of only having commercially provided payment mechanisms.

By February of 2020, China had publicly committed to proceed to issue a Digital Yuan but, interestingly, the otherwise comprehensive Canadian report does not mention this development at all nor does the second Swedish report from February 2020. Given the perspicacity of these analyses generally, this cannot be an oversight. This is particularly interesting, as the third scenario in which Canada might choose to issue a CBDC would be where a major trading partner such as China, or the US (with a Digital Dollar, infra at V(B)), issues a CBDC that is available for use in international trade.

Such a development would be highly likely to force Canada’s hand because a CBDC would interact exceptionally well with dematerialised trade documents. The potential savings from the digitisation and dematerialisation of trade documentation are massive – the paperwork associated with international shipments is estimated to comprise about 20 per cent of the total cost of the shipment.⁴³

In this ‘third’ unarticulated (by Canada) scenario, CBDC issuance by Canada or Sweden or any other country for that matter becomes compelling because, without it, much valuable information about trade contracts that use the Digital Yuan will end up in Shanghai or Beijing rather than Toronto or Stockholm. Perhaps more strongly, countries which do not have major currencies will

face increased competition from digital major currency alternatives to potentially replace the role of their own currencies in trade.

B. Singapore, the UK and Hong Kong SAR: Major International Financial Centres

While the analyses of Canada and Sweden will be relevant to most countries around the world as they will face similar challenges, the approaches of the UK and Singapore will also be watched closely given their leading roles as financial centres, particularly for FinTech and RegTech. Both have carefully focused on their positions and the role that CBDCs – particularly in the wholesale and trade contexts – could have going forward. Hong Kong is taking a similar approach, particularly in relation to its potential role as a node between China and other economies.

These jurisdictions are particularly focussed on their potential to be intermediaries: how to be a node between major digital currencies going forward? This is an issue which of course is central to Hong Kong's future most clearly, considering how it could emerge as the major point of exchange for transactions between the Digital Yuan area and the rest of the world.⁴⁴

C. The Digital Euro

In contrast to other major international players, the EU has been relatively restrained in voicing any plans to issue a Digital Euro, perhaps employing a more cautious approach to this burgeoning area of international focus. Only until very recently, did the first clear insights into the possible issuing of a CBDC for the Eurosystem come from Christine Lagarde, speaking at the Deutsche Bundesbank's Conference on Banking and Payments in the Digital World in September 2020 (the 'Conference').⁴⁵

The ECB, by its own mandate, is in the unique position to consider the merits behind issuing a Digital Euro and the further integration of payments in Europe. This mandate has perhaps found increased relevance given the accelerated use of digital and contactless payments recently, spurred on by COVID-19 in a trend which may continue well after the pandemic.⁴⁶ Lagarde's speech championed innovative digital payments and their potential to increase the efficiency of transactions and to reduce the cost thereof. By the same token however the sentiment erred on the side of caution by recognising the potential for new risks which must be balanced with the benefits of payments innovation.

This pragmatic approach to the EU's current stance on payments innovation is perhaps threatened by the perceived competition among sovereigns and private firms alike to dominate payments globally. Underlying this rhetoric, Lagarde highlighted the significance of the economy transacted through money as a fundamental expression of sovereignty, in response perhaps to how private firms are increasingly veering into central bank territory by creating their own digital currencies.

Given the aforementioned accelerated use of digital payments globally, the creation of digital currencies by private firms and recent developments in the CBDC space, it is hard not to agree with Lagarde's view that Europe had fallen behind in this global competitive landscape. Once

again, the Digital Yuan and Libra are used as examples of systemic catalysts spurring on competition and driving the need for an appropriate EU response.

A Eurosystem Task Force is currently considering the merits of issuing a Digital Euro and its *Report on a digital euro*⁴⁷ published in October 2020 (the ‘Report’) provides a glimpse into how the EU intends catching up with major international players and ensuring that its consumers have access to central bank money in accordance with their needs in the digital era. The Report is intended as the starting point for broader discussion and therefore does not provide any specific details on the chosen design choices for a Digital Euro. It does however set out how the ECB intends issuing a CBDC for Europe based on three critical elements.

These elements, discussed below, are meant to provide the foundation for the practical experimentation required to make a decision on the design features for a Digital Euro with the end goal of developing a ‘minimum viable product’. From an operational perspective the ECB intends retaining its role in issuing Digital Euro, while permitting private intermediaries to provide user-facing facilities interoperable with it.

First, a Digital Euro must comply with the Eurosystem’s core principles, mandates and policies. Among its other central guiding principles for design, a Digital Euro would not act as a parallel currency, but instead as an additional method of supplying euro to users in all euro area jurisdictions. This is consistent with Lagarde’s speech at the Conference detailing that a Digital Euro would act as a complement to cash, and not as a substitute (in line with other CBDC efforts globally). A Digital Euro would be convertible at par with banknotes, central bank reserves and commercial bank deposits in euro. It would be regarded as a Eurosystem liability and therefore characterised as risk-free central bank money. Further, the needs of consumers in utilising digital payments must be considered in the creation of a Digital Euro that does not discourage digital currency solutions developed by private firms. Finally, measures must be taken to ensure that a Digital Euro is trusted from its initial issuance, and that this trust is maintained indefinitely.

Second, 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. These pre-requisites include: (i) enhanced digital efficiency to support the digitisation of the EU’s economy; (ii) inclusion of cash-like design features (such as offline usage) to counter the general decline in cash usage; (iii) employment of cutting-edge design features to serve as an alternative competitor to existing payment solutions; (iv) consideration of a Digital Euro as a way of improving monetary policy, such as possible remuneration at modifiable interests rates; (v) usage of a Digital Euro as a back-up system available widely and separately from other payment solutions in the case of extreme events; (vi) accessibility and usage at an international level to non-euro area users; and (vii) cost reduction and environmentally friendly design features.

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 requirements include: (i) capacity to control the number of Digital Euro in circulation to avoid large investments therein which move away from private money, such as bank deposits; (ii) collaboration with market participants to utilise existing user-facing facilities; (iii) compliance with the existing regulatory standards, including payments; (iv) safe and efficient design in

compliance with the Eurosystem's goals; (v) wide accessibility and usage throughout the euro area; (vi) set conditions for use of a Digital Euro by non-euro residents; and (vii) designed to be cyber resilient. Overall, these requirements are important for ensuring that in developing a Digital Euro regard must also be had to its effect on the banking industry's financing role as consumers move their deposited money into potential Digital Euro wallets, creating possible risks to financial stability.

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.

Discussions around the possibility of a Digital Euro being provided through an account-based system or as a bearer instrument will most likely continue and be dependent on the choice of underlying back-end infrastructure. In a centralised system all Digital Euro transactions would be recorded in the Eurosystem's ledger. Whereas in a decentralised system all transactions would be recorded by the supervised intermediaries and users based on the rules set by the Eurosystem. Digital Euro will most likely be accessed via hardware such as the user devices accepted by merchants and ATMs; and software-based payment solutions will include web-based applications and interfaces, digital wallets and cards.

Finally, the legal implications for issuing a Digital Euro are also considered in the Report which concludes that EU law does not currently preclude the possibility of utilising a Digital Euro as legal tender. In addition, the practical arrangements related to the access and distribution of a Digital Euro could possibly be outsourced under Eurosystem supervision. Finally, the choice of EU law to be used as the basis of the issuance of a Digital Euro will be dependent on its design features and the principle reasons for its issuance.

On a practical level, a viable commercial case for the digital settling and delivery of financial securities using Digital Euro for interbank settlements was illustrated recently by the issue of €40 million covered bonds as security tokens directly registered on a public blockchain by Banque de France.⁴⁸ However, time will only tell the extent to which the EU will launch a Digital Euro project, together with its design choices and features and how this will impact trade at a global level operating with perhaps a Digital Yuan, and US and Canadian Digital Dollars. 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.

D. The Digital Dollar

The US Digital Dollar proposal demonstrates the Digital Yuan is not the only potential major currency CBDC with global implications: clearly a Digital Dollar would potentially have even

greater immediate impact, albeit with very different design features from those of the Digital Yuan, reflecting the very different domestic and global monetary, financial, economic and political contexts.

The ‘Digital Dollar’ proposal was included in the US legislative package of responses to the COVID-19 crisis in March 2020. It 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 could certainly be done – perhaps most likely as we suggest below – as 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).

As noted above, SDCs will interact particularly efficiently with the digitalisation of international trade processes and smart contracts. In the absence of a Digital Dollar, the Digital Yuan, once eventually allowed offshore,⁴⁹ will thus 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 US currently receives from minting the world’s global reserve currency.⁵⁰ For this reason alone, it is very difficult to see the US not launching a Digital Dollar as a defensive measure, should the prospect of the Digital Yuan being allowed to be used outside of China become imminent.

V. THE FUTURE OF MONEY AND PAYMENTS

The four catalysts of technology, Libra, the Digital Yuan and COVID-19 together provide sufficient ground to rethink the future of payments and money. In this section we present our SDC taxonomy and discuss the opportunities and challenges that come with SDCs more generally. We are particularly interested in design choices relating to CBDCs. These design choices must be based on the specific circumstances of individual economic and financial systems rather than on any single model. This was emphasised by the Bank for International Settlements (BIS) and a group of developed economy central banks in a report issued in October 2020, highlighting – even among similarly situated economies – there should be no ‘one size fits all’ CBDC.⁵¹

In their October 2020 report, the BIS and some of the world’s leading central banks, outlined a set of CBDC core features and foundational principles (the ‘BIS Report’).⁵² While recognising the role of central banks in issuing cash for use by the public, the report highlights the accelerated use of digital payments, spurred on not only by COVID-19, but also the decline in the use of cash in making payments. As such, a primary driver for central banks considering whether to issue a general purpose CBDC is how it can be used as an alternative form of money for payments, complemented by physical central bank cash. In formulating its foundational principles, the BIS Report follows a risk-based approach and points out the need to identify all potential risks associated with issuing a CBDC, particularly those which threaten financial stability, and which

may alter financial market structures negatively. Based on these considerations, the BIS Report thus outlines three important foundational principles for central banks to consider in issuing a CBDC. First, financial stability should not be comprised in issuing a general purpose CBDC. Central banks must still be able to perform their core role of maintaining monetary and financial stability and should not be deterred by the issuance of a CBDC. Second, a general purpose CBDC should be used alongside and complement existing forms of money. Last, a general purpose CBDC must promote innovation and competition to increase efficiency and provide users with access to a safe form of money. Overall, the BIS Report highlights the continued work of the world's leading central banks in deciding whether to issue a CBDC. It is by no means meant to be definitive on whether those decisions have in fact been made. The BIS' work will therefore continue, particularly its next phase involving additional policy analysis and CBDC design choice and technical experimentation.

A. SDC Taxonomy

SDC projects typically differ across four major design parameters: (1) users; (2) architecture; (3) technology; and (4) scope.

(1) 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.⁵³

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.

(2) Architecture

As to architecture we distinguish between three different kinds of SDCs,⁵⁴ including:

(I) 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.⁵⁵ By design,⁵⁶ centralised SDCs are permissioned systems and lack cash-like qualities, in particular anonymous exchange.⁵⁷ However, as an intermediary-based system, security and anti-fraud features would be easier to incorporate into such a system.⁵⁸

(II) Decentralised SDCs

A *decentralised* SDC bears the closest resemblance to Bitcoin and other decentralised digital APS. 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 making peer-to-peer and offline payments easier.⁵⁹ Technically, full decentralisation is achievable through tokenisation.

(III) 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. 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.

(3) Technology

Technology remains an evolving choice, with some systems centralised using traditional payments processing technologies (e.g. RTGS) and others based on DLT/blockchain, an issue we return to below.

(4) Scope

The system may extend only to monetary arrangements or to payment arrangements or it may include elements of both. We return to this issue below as well.

B. Benefits, Opportunities and Challenges

(1) 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.⁶⁰ Such a design would bring a number of benefits, including:

- (I) 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;

- (II) central banks and governments could modernise their ageing wholesale payment systems with advanced functionality including support for smart contracts;⁶¹ and
- (III) SDCs can also be used for raising money by the state – a feature of Venezuela’s Petro,⁶² an asset-backed cryptocurrency which was designed to supplement Venezuela’s ailing economy, raise capital and attract investment by circumventing US sanctions – this feature remains possible notwithstanding that for other reasons the Petro did not succeed.

(2) Challenges

Regulatory challenges relating to SDCs include:

- (I) 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;
- (II) concerns about the impact of SDCs on the payment system, financial markets and economy:
 - a. 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 (e.g. commercial banks, electronic money issuers);
 - b. alternately, 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);
 - c. regulators must also consider implications for money supply and whether the new currency will be issued via an ICO (‘initial coin offering’) or in exchange for other forms of sovereign money (e.g. cash) or commercial bank money (or both) and design corresponding conversion mechanisms; and
- (III) 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 regulation of non-sovereign cryptocurrencies.

C. Technology: Departure from DLT

An often-discussed aspect of CBDCs is technology.⁶³ Although the examination of the option of issuing a 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, ‘[a]lthough 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'.⁶⁴ And, according to a recent BIS report, only five out of 17 general access SDC projects presently focus on using DLT.⁶⁵

Fully decentralised systems will 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.⁶⁶

Further design choices made more difficult to address by a DLT environment relate to cybersecurity, the rectification of mistakes/erroneous payments and user identification. In light of all these factors, we expect most SDCs not to use DLT or blockchain.⁶⁷

D. 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. That 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.⁶⁸ Here, full disintermediation may be favoured since intermediary-based coverage does not 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 well prefer retail access.

E. Towards Public-Private Partnerships

Within this framework we envisage three alternative approaches: (i) central bank accounts with general access; (ii) central bank accounts with intermediated access; and (iii) new digital forms of fiat currency.⁶⁹

Within these three approaches option (i), 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. There is little evidence central banks could handle efficiently day-to-day operations with millions of retail clients 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. Further, 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, TechFins and FinTechs to utilise their existing infrastructure. To our minds, successful CBDCs will most likely be public-private partnerships, 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 FPS, 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.

F. 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.⁷⁰ In particular, rather than issuing a SDC, a central bank might allow the creation of a stablecoin, backed by deposits of fiat currency with the central bank – what the IMF has called a ‘synthetic CBDC’,⁷¹ which could effectively serve as sovereign currency in specific systems.⁷²

Fundamentally, regulators must determine whether they want to build a monetary or a payment system. The word *currency* implies building the former. But this is only achievable if the SDC is designed to substitute for cash, that is with anonymous transactions and payment finality. As we have 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.

We suggest 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 DC/EP 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 US, UK and most developing countries), a centralised account structure may well prove more efficacious.

CONCLUSION

The systemic catalysts of Libra, the Digital Yuan and COVID-19 have each challenged policy makers and regulators around the globe. Global stablecoins represent a real threat to existing payments infrastructure and a unique opportunity for payment systems to evolve dramatically.

As we have shown, there is no single model for SDCs and we have argued that 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 *efficient* digital monetary and payment systems will most likely be neither 'public' nor 'private' but rather arise from public-private partnerships.

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¹ See Didenko AN, Buckley, RP. The Evolution of Currency: Cash to Cryptos to Sovereign Digital Currencies. *Fordham Int'l LJ*. 2019;42(4):1041-1095; Taylor MW, Arner DW, Gibson EC. Central Banks' New Macroprudential Consensus. In: Mayes DG, Siklos PL, Sturm J, editors. *The Oxford Handbook of the Economics of Central Banking*. Oxford (GB): Oxford University Press; 2019. p.482-502.

² For different approaches to the design of payment systems and the role of the central entity, see Taylor, Arner, Gibson, ref 1. above p.148; For the history of payment systems and the law governing them, see, Geva B. *The Payment Order of Antiquity and the Middle Ages: A Legal History*. Oxford (GB): Hart; 2011; Geva B. *Cryptocurrencies and the Evolution of Banking, Money and Payments*. In: Brummer C, editor. *Cryptoassets Legal, Regulatory and Monetary Perspectives*. Oxford (GB): Oxford University Press; 2019. p.11-38.

³ 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. See The World Bank. *Global Payment Systems Survey (GPSS) 2012; Section VIII: Reforming the National Payments System*. [internet]. 2012. Available from: <<https://www.worldbank.org/en/topic/financialinclusion/brief/gpss>>.

⁴ Being the domain of integrity related regulation such as the FATF's AML/CTF standards, we do not consider in detail integrity as a separate objective in this article but understand integrity as inherent to the safety objective.

⁵ For a discussion about interrelation between transaction costs and economic growth more generally see Bywaters D, Mlodkowski P. *The Role of Transaction Costs in Economic Growth*. *Intl J Econ Pol'y Studies*. 2012;7:53-66.

⁶ Bank for International Settlements, International Organization of Securities Commissions. *Principles for Financial Market Infrastructures*. [internet]. BIS, IOSCO; 2012 Apr. Available from: <<https://www.bis.org/cpmi/publ/d101a.pdf>>.

⁷ See Financial Stability Board. *Addressing the Regulatory, Supervisory and Oversight Challenges Raised by "Global Stablecoin" Arrangements: Consultative Document*. [internet]. FSB; 2020 Apr. Available from: <<https://www.fsb.org/2020/04/addressing-the-regulatory-supervisory-and-oversight-challenges-raised-by-global-stablecoin-arrangements-consultative-document/>>.

⁸ See Barontini C, Holden H. *Proceeding with Caution – A Survey on Central Bank Digital Currency*. *BIS Papers No 101*. [internet]. BIS; 2019 Jan. Available from: <<https://www.bis.org/publ/bppdf/bispap101.pdf>>.

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- ⁹ See Arner DW, Barberis J, Buckley RP. The Evolution of FinTech: A New Post-Crisis Paradigm. *Geo J Int'l L.* 2016;47(4):1271-1320.
- ¹⁰ See G7 Working Group on Stablecoins, Investigating the Impact of Global Stablecoins. [internet]. G7, IMF, BIS; 2019 Oct. Available from: <<https://www.bis.org/cpmi/publ/d187.pdf>>.
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- ¹² Libra Association Members. White Paper v2.0. [internet]. 2020 Apr. Available from: <<https://libra.org/en-US/white-paper/>>.
- ¹³ Ibid.
- ¹⁴ Ibid.
- ¹⁵ Ibid.
- ¹⁶ Libra Association Members. *White Paper v1.0.* [internet]. 2019 Jun. Available from: <https://libra.org/en-US/wp-content/uploads/sites/23/2019/06/LibraWhitePaper_en_US.pdf>.
- ¹⁷ Libra Association Members, ref 12. above.
- ¹⁸ BIS. Global Systemically Important Banks: Assessment Methodology and the Additional Loss Absorbency Requirement. [internet]. 2020 Apr. Available from: <<https://www.bis.org/bcbs/gsib/>>.
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- ²¹ FSB. FSB Consults on Regulatory, Supervisory and Oversight Recommendations for “Global Stablecoin” Arrangements. [internet]. FSB; 2020 Apr 14. Available from: <<https://www.fsb.org/2020/04/fsb-consults-on-regulatory-supervisory-and-oversight-recommendations-for-global-stablecoin-arrangements/>>.
- ²² FSB. Regulation, Supervision and Oversight of “Global Stablecoin” Arrangements. Available from: <<https://www.fsb.org/wp-content/uploads/P131020-3.pdf>>.
- ²³ Fnlity Press Office. Utility Settlement Coin (USC) Continues to Evolve. FNALITY [internet]. 2019 Jun 3. Available from: <<https://www.fnality.org/news-views/usc-continues-to-evolve>>.
- ²⁴ See Murphy H, Yang Y. Patents Reveal Extent of China’s Digital Currency Plans. *Financial Times* [internet]. 2020 Feb 13. Available from: <<https://www.ft.com/content/f10e94cc-4d74-11ea-95a0-43d18ec715f5>>. In 2018, the Bank for International Settlements (BIS) conducted a survey among 63 central banks from countries representing circa “80% of the world’s population and over 90% of its economic output” to measure the current state of development of so-called “central bank digital currencies” (CBDC). Some 70% of respondents were working on CBDCs or were planning to do so soon. See Barontini, Holden, ref 8. above. A similar survey conducted one year later showed this percentage had grown to 80%. See Boar C, Holden H, Wadsworth A. Impending Arrival – A Sequel to the Survey on Central Bank Digital Currency. BIS Papers No 107. [internet]. BIS; 2020 Jan. Available from: <<https://www.bis.org/publ/bppdf/bispap107.pdf>> at 3.
- ²⁵ We have used the best sources available to us for this section, but our analysis may be influenced by their reliability or the quality of their translation into English.
- ²⁶ We predicted this response in an article posted online on 11 July 2019: see Zetsche, Buckley, Arner, ref 11. above.
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³² See Reserve Bank of Australia, RMB Internationalisation: Where to Next?. RBA [internet]. 2018 Sept 20. Available from: <<https://www.rba.gov.au/publications/bulletin/2018/sep/pdf/rmb-internationalisation-where-to-next.pdf>>; Arner D, Soares A. A Globalized Renminbi: Will It Reshape Latin America?. [internet]. Washington DC: Atlantic Council; 2016 Oct. Available from: <<https://www.atlanticcouncil.org/in-depth-research-reports/report/a-globalized-renminbi/>>; Overholt W, Ma G, Law CK. RMB Rising: A New Global Monetary System Emerges. Chichester (GB): Wiley; 2016; Brummer C. RMB Ascending: How China's Currency impacts Global Markets, Foreign Policy and Transatlantic Financial Regulation. [internet]. Washington DC: Atlantic Council; 2015 Jun. Available from: <<https://www.atlanticcouncil.org/in-depth-research-reports/report/renminbi-ascending-how-china-s-currency-impacts-global-markets-foreign-policy-and-transatlantic-financial-regulation/>>.

³³ Khadem N. Coronavirus Crises Spark Large Bank Withdrawals, Despite Looming Cash Transaction Ban. ABC News [internet]. 2020 May 26. Available from: <<https://www.abc.net.au/news/2020-05-26/digital-world-without-cash-post-the-coronavirus-pandemic/12282856>>. A coalition of central banks have committed to work together to assess CBDC use cases and design choices. These comprise the Bank of Canada, Bank of England, Bank of Japan, European Central Bank, Sveriges Riksbank and Swiss National Bank. The Peoples Bank of China is not a member, although its work is more progressed than any other central bank. Other central banks that have announced they are researching or testing use cases for CBDC include: Ukraine, France, Thailand, South Korea, Uruguay, Turkey, The Bahamas, South Africa, Eastern Caribbean Currency Union, Saudi Arabia, Marshall Islands, UAE, Brazil, Israel, Norway, Cambodia, Denmark, Ecuador, and Iceland. See Davis Polk, Client Memorandum, "The Federal Reserve and Central Bank Digital Currencies" August 20, 2020, available at <https://alerts.davispolk.com/10/5131/uploads/the-federal-reserve-and-central-bank-digital-currencies.pdf?sid=281566df-9de6-477a-9d7e-834d74e82e20>

³⁴ Yeung, ref 28. above.

³⁵ This is only implied in the two reports: Sveriges Riksbank. The Riksbank's E-krona Project. Report No 1. Sveriges Riksbank; 2017 Sept [*E-krona Project Report No 1*]; Sveriges Riksbank. The Riksbank's E-krona Project. Report No 2. Sveriges Riksbank; 2018 Oct [*E-krona Project Report No 2*].

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³⁸ Ibid.

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⁴⁰ Huynh K. How Canadians Pay for Things. [internet]. Bank of Canada; 2019 Oct. Available from: <<https://www.bankofcanada.ca/2019/10/how-canadians-pay-for-things/>>.

⁴¹ Doyle M, Fisher C, Tellez E, Yadav A. How Australians Pay: New Survey Evidence. RBA Bulletin; 2017 Mar. p.60; Sveriges Riksbank. The Riksbank's E-krona Project. Report No 1. Sveriges Riksbank; 2017 Sep. p.7; Caddy C, Delaney L, Fisher C, Noone C. Consumer Payment Behaviour in Australia. [internet]. RBA Bulletin; 2020 Mar. Available from: <<https://www.rba.gov.au/publications/bulletin/2020/mar/consumer-payment-behaviour-in-australia.html#:~:text=The%202019%20Consumer%20Payments%20Survey,to%20that%20recorded%20in%202016>>; Sveriges Riksbank. Cash Use in Constant Decline. [internet]. Sveriges Riksbank; 2019 Nov 7. Available from: <<https://www.riksbank.se/en-gb/payments--cash/payments-in-sweden/payments-in-sweden-2019/the-payment-market-is-being-digitalised/cash-use-in-constant-decline/>>. For data on the decline in use of cash over time in each of Canada, Australia and Sweden, see Huynh, ref 39. above.

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⁴³ The Digitisation of Trade's Paper Trail May Be at Hand. The Economist [internet]. 2018 Mar 22. Available from: <<https://www.economist.com/finance-and-economics/2018/03/22/the-digitisation-of-trades-paper-trail-may-be-at-hand>>.

⁴⁴ Mukherjee A, "Crypto Yuan Will Meet the Dollar — in Hong Kong", Bloomberg August 24, 2020.

⁴⁵ Christine Large, 'Payments in a digital world' (European Central Bank, 10 September 2020) <<https://www.ecb.europa.eu/press/key/date/2020/html/ecb.sp200910~31e6ae9835.en.html>> accessed 28 September 2020.

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<https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/europes-digital-migration-during-covid-19-getting-past-the-broad-trends-and-averages>> accessed 6 October 2020.

⁴⁷ ‘Report on a digital euro’ (European Central Bank, 2 October 2020) <

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⁴⁸ Societe Generale performs the first financial transaction settled with a central bank digital currency’ (Societe Generale, 20 May 2020) < <https://www.societegenerale.com/en/NEWSROOM-first-financial-transaction-settled-with-a-digital-currency>> accessed 28 September 2020.

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⁵⁰ Eichengreen B. Exorbitant Privilege: The Rise and Fall of the Dollar and the Future of the International Monetary System. Oxford (GB): Oxford University Press; 2012.

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⁵⁵ This is in contrast to token-based verification that is based on the validity of the actual units of currency (similar to the operation of cash, but in a digital format). For more detail, see Committee on Payments and Market Infrastructures. Central Bank Digital Currencies. [internet]. BIS; 2018 Mar. Available from: <<https://www.bis.org/cpmi/publ/d174.pdf>> p.4.

⁵⁶ In theory, it is of course conceivable that the state may try to label a centralised SDC as “anonymous” or “cash-like”, but such an attempt would raise major credibility concerns: “In theory, a government could itself offer debit accounts that were guaranteed to be private. Unfortunately, that promise would not be worth the paper it was written on, so to speak. Given governments’ past behaviour, who could take such a promise seriously?” See Rogoff KS. The Curse of Cash. Princeton (US): Princeton University Press; 2016 p.102.

⁵⁷ In its second report on the E-krona project, Swedish Riksbank concludes that the “focus of this programme should be on developing an e-krona that constitutes a *prepaid value* (electronic money) without interest and with *traceable transactions*.” See Sveriges Riksbank. E-krona Project. Report No 2. [internet]. Sveriges Riksbank; 2018 Oct. Available from: <<https://www.riksbank.se/en-gb/payments--cash/e-krona/e-krona-reports/e-krona-project-report-2/>>; See also Birch D. Bitcoin or Brit-PESA?. Consult Hyperion [internet]. 2016 Jan 4. Available from: <<https://www.chyp.com/bitcoin-or-brit-pesa/>>.

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⁶⁵ See Auer R, Cornelli G, Frost J. Taking Stock: Ongoing Retail CBDC Projects. [internet]. BIS March Quarterly Review; 2020 Mar 1. Available from: <https://www.bis.org/publ/qtrpdf/r_qt2003z.htm>.

⁶⁶ Ibid.

⁶⁷ DLT has been criticised by some central banks as lacking adequate scalability, offering no fundamental advantages over existing systems or failing to ensure cash-like resilience during blackouts. See Auer, Cornelli, Frost, *ibid*.

⁶⁸ See, for instance, Corneille E, “Cambodian central bank implements first retail payments system in the world using blockchain technology”, Bloomberg August 24, 2020.

⁶⁹ For a more detailed discussion of available approaches see Didenko, Buckley, ref 1 above, pp.1085-1093.

⁷⁰ See e.g.: Societe Generale. Societe Generale performs the first financial transaction settled with a Central Bank Digital Currency. [internet]. 2020 May 20. Available from: <https://www.societegenerale.com/en/NEWSROOM-first-financial-transaction-settled-with-a-digital-currency>.

⁷¹ See Adrian T, Mancini-Griffoli T. From Stablecoins to Central Bank Digital Currencies. IMF Blog [internet]. 2020 Sept 26. Available from: <<https://blogs.imf.org/2019/09/26/from-stablecoins-to-central-bank-digital-currencies/>>; Adrian T, Mancini-Griffoli T. The Rise of Digital Money. FinTech Notes No 19/01. [internet]. IMF; 2019 Jul. Available from: <<https://www.imf.org/en/Publications/fintech-notes/Issues/2019/07/12/The-Rise-of-Digital-Money-47097>>.

⁷² Allison I, Palmer D. Wells Fargo to Pilot Dollar-Linked Stablecoin for Internal Settlement. Coindesk [internet]. 2019 Sep 17. Available from: <<https://www.coindesk.com/wells-fargo-to-pilot-dollar-linked-crypto-for-internal-settlement>>.