DIGITAL CURRENCIES AND STABLECOINS

Risks, Opportunities, and Challenges Ahead

G30 GROUP OF THIRTY

Disclaimer

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Copies of this paper are available for US$25 from:
The Group of Thirty
1701 K Street, N.W., Suite 950
Washington, D.C. 20006
Tel.: (202) 331-2472
E-mail: info@group30.org, www.group30.org

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WORKING GROUP ON DIGITAL CURRENCIES

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Former Governor, Reserve Bank of India

Kenneth Rogoff, Co-Chair
Professor of Economics, Harvard University
Former Chief Economist, International Monetary Fund

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Chairman, Monetary Authority of Singapore

Zhou Xiaochuan
President, China Society for Finance and Banking
Former Governor, People's Bank of China

PROJECT ADVISORS

Darrell Duffie
Adams Distinguished Professor of Management and Professor of Finance, Stanford Graduate School of Business

Hyun Song Shin
Economic Adviser and Head of Research, Bank for International Settlements

EXPERTS

Stuart Mackintosh
Executive Director, Group of Thirty

Mu Changchun
Director-General of the Digital Currency Institute, People's Bank of China

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FOREWORD

The Group of Thirty (G30) aims to deepen understanding of international economic and financial issues, and to explore the international repercussions of decisions taken in the public and private sectors. This report, *Digital Currencies and Stablecoins: Risks, Opportunities, and Challenges Ahead*, continues the G30's over 40-year tradition of evidence-based, actionable study.

Decisions taken by policymakers on digital currencies, now and over the next few years, could potentially shape the global financial system for decades to come. The report urges that central banks and regulators take an active role in setting standards and in shaping or providing market infrastructure, and not leave design purely to market forces. Moreover, there is a compelling case for international cooperation on these issues, which extends to data-sharing protocols and cybersecurity, among other issues.

This report hopes to guide central banks and regulators as they consider the policy choices presented by new payment technologies and the entrance of tech players into the global payments arena. How can we improve the efficiency of payment systems while safeguarding financial stability, monetary policy transmission channels, financial inclusion, investor protection, and countering illicit activities? Under what parameters should central banks deploy their own digital currencies?

We hope that the report's recommendations, when taken together and considered within the context of national economies and financial systems, will support the necessary debate on how the financial system can best provide efficiency and stability going forward.

On behalf of the G30, we extend our thanks to Raghuram Rajan and Kenneth Rogoff for their extremely able co-chairing of the Working Group on Digital Currencies, and to the two Project Advisors, Darrell Duffie and Hyun Song Shin, for the considerable expertise and thought they brought to the report's analysis and recommendations.

Jacob A. Frenkel
Chairman, Board of Trustees
Group of Thirty

Tharman Shanmugaratnam
Chairman
Group of Thirty

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We would like to thank the members of the Steering Committee and Working Group on Digital Currencies, who guided our collective work at every stage and added their unique insight and inputs. The intellect and experience they brought to the table have been paramount in informing the important subject of digital currencies and stablecoins and the challenges they present to policy makers, central banks, and financial regulators.

The G30 extends its deep appreciation to the Project Advisors, Darrell Duffie and Hyun Song Shin, for their commitment to the project and tireless work and contributions to the analysis and formulation of the report.

The coordination of this project and many aspects of project management, Working Group logistics, and report production were centered at the G30 offices in Washington, D.C. This project could not have been completed without the efforts of our editor, Diane Stamm, and the work of Executive Director Stuart Mackintosh and his team, including Desiree Maruca, Emma Prall, and Peter Bruno of the G30. We are grateful to them all.

Raghuram Rajan
Co-Chair
Working Group on Digital Currencies

Kenneth Rogoff
Co-Chair
Working Group on Digital Currencies

ABBREVIATIONS

AML/CFT	anti-money laundering/combating the financing of terrorism
APIs	Application Process Interfaces
CBDC	central bank digital currency
DC/EP	Digital Currency Electronic Payment (China)
DNA	data-network-activities
FINMA	Financial Market Supervisory Authority (Switzerland)
fintech	financial technology
HKMA	Hong Kong Monetary Authority
HQLA	high-quality liquid assets
KYC	Know Your Customer
PSPs	Payment System Providers
RTGS	Real Time Gross Settlement
UPI	Universal Payment Interface

INTRODUCTION

Recent developments have heightened the attention of financial authorities to opportunities and challenges posed by new forms of digital currency, including privately-issued "stablecoins" as well as central bank digital currencies. This paper aims to contribute to that discussion. As central banks and finance ministries consider how to respond to the rapidly evolving digital payments landscape, they could revisit more basic choices regarding monetary arrangements. These include the foundational role of the central bank as well as more detailed policy choices concerning how to: ensure the continued operation of monetary policy transmission channels; improve the efficiency of payment systems—especially across borders; safeguard financial stability; expand financial inclusion; enhance investor protection; and counter illicit activities. How can central banks make the best use of the possibilities afforded by new payment technologies, especially digital currencies? Should central banks deflect or support "tech" entrants to the payments arena? If they support tech entrants, should these new players be accommodated into the current two-tier monetary architecture, with the central bank at the core of the system, and whose inner tier has until now been essentially restricted to banks? Although the focus of this note is central bank policy, the challenge posed by disruption from digital currencies affects all branches of government, not to mention international financial organizations such as the International Monetary Fund and the World Bank. Of course, private-sector financial firms and Fintech innovators also have a huge stake in how financial regulation evolves to shape the landscape.

Central banks have allowed a variety of innovations in payment mechanisms, with a view to enhancing competition among them. Barriers to entry can be lowered when innovative private solutions can be plugged into public infrastructure, including central bank settlement accounts. Several central banks have responded to the emergence of new non-bank payment service providers (PSPs) by expanding access to central bank settlement accounts with a view to enhancing competition. Each of these innovations is based on a division of labor by which the official sector provides the core infrastructure while private-sector entrants draw on their innovative capacity.

During the early development of digital currencies, authorities generally took a hands-off attitude, not wanting to interfere with technological innovation. Whereas technological development remains an important objective, we argue that the time has come for the official sector to play a more decisive role in shaping developments.

In the near term, a policy of requiring new payment technology providers to meet at least existing functional outcome standards seems obvious. As new payment methods appear, relevant regulatory frameworks need to be mapped and checked for coverage of all critical standards, including investor protection rules, principles for financial market infrastructure, and various standards for the legality of transactions (for example, with respect to anti-money laundering and countering the financing of terrorism), among other relevant regulations. Some new payment technologies cut across traditional lines of jurisdictional responsibility, calling for coordination among regulators, domestically and internationally.

Over the medium term, a number of other policy questions will become salient. These include:

1. Should central banks issue their own digital currencies for use in the broader economy, or is the better strategy to update and upgrade existing structures?

2. What is the appropriate degree of competition between domestic digital currencies, especially between private versions and the central bank version?

3. How should a central bank or legislature react if a non-native digital currency is gaining domestic popularity in payments relative to the native fiat currency?

4. What is the appropriate public policy stance on the disruption of conventional banking by payment system innovation?

5. What policy approaches are needed to promote the security of the payment system as digital innovations continue to evolve?

6. What should be the protocols for acquiring, owning, and sharing data collected in domestic payments transactions? How should these apply to the international sharing of transactions data?

Before addressing these questions, it is useful to clarify certain terminology. Payments can be small-value retail payments or large-value wholesale payments. Payments usually have a front end (how the payment is initiated) and a back end (how it is cleared and settled). For example, I initiate a payment to my landlord by sending her a check, and the process by which the money shows up in her account involves clearing and settling—with money effectively moving from my bank's account with the central bank to her bank's account with the central bank as final settlement. Underlying all transactions is the country's fiat currency, which simultaneously serves as a unit of account, a medium of exchange, and a store of value.

This two-tier system—with the public having digital accounts with commercial banks from which they can make payments and withdraw physical cash, and commercial banks having accounts with the central bank—is the current system in much of the world. As discussed above, in recent years, central banks have expanded the set of financial institutions that have central bank accounts, more payments are initiated digitally rather than through checks, and there is a constant effort to clear and settle transactions more quickly, but the fundamental architecture has remained the same.

A private cryptocurrency such as Bitcoin is a digital token that can be transferred from peer to peer via cryptographic schemes that do not require identification. Cryptocurrencies offer varying degrees of anonymity depending on the nature of the cryptographic scheme. They employ a variety of mechanisms to clear transactions; "permissioned" systems rely on a central authority, which is the final arbiter of the clearing of transactions (and therefore has access to the necessary records), while "permissionless" systems, such as Bitcoin and Etherium, use cryptographic methods to clear peer-to-peer transactions with no centralized clearing authority.1 Finally, some cryptocurrencies fluctuate significantly in value while others do not, or are structured to avoid revaluation.

Central bank issued digital currencies (CBDCs) can also take different forms.[2] With indirect CBDC (which resembles the current two-tier system), the customer holds a claim on the intermediary, while the central bank focuses on wholesale accounts, including intermediary accounts at the central bank. So, for instance, the intermediary issues digital tokens to the customer (which are claims on the intermediary), and handles Know Your Customer (KYC) issues and disputes. Information on transactions resides with intermediaries. The customer claims on the intermediary are fully backed by intermediary claims on the central bank.

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1 Throughout we use "permissioned" to refer to technologies where a central authority is involved in clearing transactions and "permissionless" to refer to ones where record-keeping can be decentralized. We recognize that "permissioned" is sometimes used differently in the crypto literature, but our distinction is the important one for the issues studied here. Although Bitcoin is permissionsless in theory, we note that, in practice, most Bitcoin transactions are actually made on organized exchanges.

2 The following paragraph draws on Auer and Böhme (2020).

Direct CBDC can take two forms. In the first, everyone holds accounts at the central bank and any payment transaction is simply a transfer from one account to another. In the second, the central bank issues a digital token, and manages a permissioned system to clear transactions. While the central bank can enlist intermediaries to do the initial KYC, all claims are on the central bank, and all information on transactions resides with it. Because it has the data, the responsibility of maintaining the customer relationship, including KYC, may inevitably devolve on the central bank.

In the hybrid CBDC, the claim is once again on the central bank, but the private intermediary plays a much bigger role in transaction messaging. One example would be the issuance of a central bank digital token in lieu of cash (see the box 4 on the Chinese CBDC), with depositors able to withdraw digital tokens or cash from their account at the intermediary. Another would be the intermediary offering its depositors individual accounts at the central bank, with transactions initiated via the intermediary.

Both direct CBDC and hybrid CBDC raise concerns about possible disintermediation of private entities, especially in times of stress. Today, someone wanting a claim on the central bank must withdraw and store physical cash, which entails transaction costs. When the conversion to a CBDC from a deposit account at the intermediary is just one click away, the transaction costs are effectively zero.

Having painted the landscape, albeit with a relatively broad brush, let us return to the original questions with which we started. We emphasize four points. First, a key decision for central banks is how much to encourage new digital-token technologies, or even to create a general-purpose central bank digital currency, as opposed to strengthening existing frameworks. For example, much can be done to expand the speed and availability of real-time clearing mechanisms, so that even retail transactions are cleared instantaneously, 24/7.

Second, even if there is a desire to encourage new technologies, there is still a variety of choices that can be made on the specific architecture. For instance, "permissioned" systems allow authorities more control and more data, but raise issues of privacy and data use. Permissionless systems bring advantages associated with anonymity, but also bring risks.

Third, governments must be able to collect taxes, enforce regulations, and limit illicit transactions. They cannot idly allow a large fraction of their economy's payments to be made through vehicles that are excessively costly to audit, either because of technology or because the key data are kept by a foreign government or a private entity outside their regulatory reach. At the same time, the more the central bank is involved in payments, the more issues arise regarding whether central-bank-collected data are appropriately used or disseminated, and whether the private sector has adequate incentives for innovation.

Fourth, and perhaps most fundamentally for central banks, before any payments system is allowed to handle a significant fraction of transactions, it must be proven exceedingly robust to breakdown, to theft, and to malicious destruction, including by state-sponsored agents. In the world of modern cryptography, with constantly improving methods for breaking encryption, demonstrating such robustness is no small challenge. It may take many years, potentially even decades, to satisfactorily harden a new payments system. (Even then, a payments system could be vulnerable to new technologies, such as quantum computing.)

Even while we recognize both the merits of the current system and the risks associated with change, we should acknowledge the potential for significant contributions to growth and inclusion with sound digitally enhanced payment systems. For instance, the data on payments can be used to offer financial products like credit in ways that significantly expand financial access and competition, and innovative new instruments that reprice or incorporate contractual contingencies can augment "plain-vanilla" payments, thus bringing down transaction costs and a variety of risks.[3] New digital token technologies also allow for the possibility of a vastly more efficient cross-border payment system that helps bring down the high transaction costs and economic rents currently embedded in it.

With this introduction, we turn to a deeper exploration of the key issues.

3 See, for example, Boissay et al. (2020).

1. BACKGROUND

Why do token-based payment systems pose such a new and potentially radical challenge to existing financial structures? Although there have been successive waves of innovations in payment technologies over the last century, nothing until now has really posed the same degree of challenge to the long-standing two-tier system, with central banks at the hub and private banks (and related financial intermediaries) as the spokes. Credit cards, debit cards, electronic transfers, smart technologies, and essentially all innovative payment schemes are ultimately cleared through this two-tiered payment system.

Indeed, ever since bank-account-based money began significantly displacing token-based money in 17th-century Europe, there has been little conceptual change in payment mechanisms. A payment is made when a bank debits the account of the payer and credits the account of the receiver. Although the electronification of deposit-based payments increased the speed and convenience of payments, the basic architecture has remained relatively constant.

Shortcomings in the performance of account-based payment systems—for example, high intermediation costs (particularly for international transactions) and constraints on real-time clearing of transactions—have left openings for tech sector entrants offering digital tokens, elevating the question of whether central banks should deploy their own general-purpose digital currencies and, if so, in what form.

DEPOSIT-BASED SYSTEMS

Before considering the far-reaching changes to the payment systems that are made possible by technological advances, improvements to the current system should be explored in order to better understand their limits. Deposit-based payment systems are conventionally two-tiered: within the monetary system associated with a currency, the central bank is the banker for commercial banks, which in turn provide payment-system access to others. Typically, domestic payments are settled with finality on the central bank's balance sheet through accounts provided to commercial banks and other payment service providers (PSPs). In the cross-border context, payments are typically processed through correspondent banks, but with significant costs in terms of delays and fees. The costs are larger when cross-border payments also involve currency conversion.

Domestic payment systems have made important strides in terms of speed, convenience, and cost for the user. However, progress has not been uniform across jurisdictions, in some cases still leaving significant rents for payment service providers (mainly banks), even in the United States. Based on payment revenue data reported in a recent McKinsey study, the ratio of payment revenues to GDP in the United States was 2.37 percent, while it was only 1.25 percent in Europe, the Middle East, and Africa.[4] Similarly, although card spending in China is nearly 1.5 times that of the United States, it generates a revenue margin

4 McKinsey Global Payments Report 2019.

of roughly 1 percent compared to 3.5 percent in the United States.

Ideally, a retail payment system would combine ease of use, easy access, and a level playing field on which all system operators can compete. Some of the biggest advances in retail payments have occurred in developing economies that are less hampered by legacy systems and the entrenched vested interests of incumbent players. The Indian Unified Payments Interface (UPI) is a good example of such an innovation and will be discussed below.

Attributes that ensure ease of use, access, and competition should include the following features. First, anyone who holds an account in a bank or non-bank financial institution can send and receive money from anyone else within the system, at low latency and cost. This feature, "interoperability," is most conducive to achieving equal conditions and low costs for users. Second, payments should settle in real time and with finality. Third, transaction costs should be low. This typically requires the system to operate as a public infrastructure, on a cost recovery basis.

More broadly, innovative private solutions that can be plugged into the existing public infrastructure can be an important step toward lowering barriers to entry within the existing two-tier payment system, with central banks at the center, and banks and other payment service providers providing customer-facing services. Several central banks have responded to the emergence of new non-bank payment service

BOX 1. THE INDIA STACK: PUBLIC INFRASTRUCTURE, LARGELY PRIVATE PROVISION

In 2008, only one in 25 people in India had formal identification, and around one in four Indian adults had a bank account.* By some estimates, it would have taken 47 years for 80 percent of adults to have a bank account in the normal course. Yet, between 2011 and 2017, over 1.2 billion Indians obtained a unique biometrics-based digital ID (called Aadhaar), which was used to authenticate identities some 900 million times a month. Over 470 million Indian adults opened a bank account in a financial institution, and the share of the population with access to banking exceeded 80 percent. Digital retail payments using the Unified Payments Interface (UPI) exceeded a billion transactions a month by November 2019. All of this was made possible on public infrastructure called the India Stack.

The India Stack is a set of standards, infrastructure components, and independent application programming interfaces (APIs) or platforms, each focused on a specific task, yet capable of being laced together (or stacked) so that they can execute a general task. The intent is to allow all firms—irrespective of size—to have equal access to the Stack, thus creating the broadest network effects for all, even while encouraging innovation. The Stack also has structures for individuals to share the data that is gathered on them.

The first platform on the Stack was Aadhaar, India's unique digital identity system. E-KYC, the digitalization of Know Your Customer (KYC), was launched soon after, allowing for easier opening of bank accounts. Since then, other platforms like digital signature (for authentication), a digital document repository, and the Universal Payment Interface (UPI) have been launched. In addition, account aggregators now facilitate the transfer of financial data among various regulated financial institutions such as banks, insurance companies, and pension funds based on the individual's consent. Thus, not only are the individual's data aggregated, but neither the state nor any private entity that collects the data has a monopoly. Such account aggregators can emerge in other areas, like medical data.

UPI is an instant real-time retail payment system, using an open API architecture developed by the National Payments Corporation of

providers by expanding access to central bank settlement accounts, with a view to enhancing competition. For example, in 2017, the Bank of England adjusted its settlement accounts policies to allow access by non-bank payment service providers. In May 2018, the Hong Kong Monetary Authority (HKMA) published guidelines for a "virtual banking" license. The HKMA subsequently granted virtual banking licenses to a number of new financial technology (Fintech) entrants to the banking system. As licensed banks, these entities will be required to join the real-time gross settlement system (RTGS) and open a settlement account with the HKMA. Another example is Switzerland, where Fintech firms licensed under the Swiss Financial Market Supervisory Authority (FINMA) are allowed access to an account at the Swiss National Bank.

In all of these examples, there is a division of labor by which the official sector provides the core infrastructure while private sector entrants can draw on their innovative capacity to serve customers better. To reap the benefits of this division of labor, the core infrastructure provided by the central bank should build in a robust "back end" that promotes interoperability and a level competitive playing field among payment service providers. The Indian UPI system (see box 1) is an example of how such an infrastructure might be provided by the central bank. There is also scope for enhancing standards that promote such interoperability, such as the ISO 20022 SWIFT

India, (NPCI)—a nonprofit owned by the Reserve Bank of India (RBI) and 56 commercial banks. It has the following characteristics:

- UPI allows a wide range of methods for customers and operators to transfer funds within the system, using a virtual payment address, UPI ID, a mobile number, a bank code and account number, an Aadhaar number, or even a QR code.* UPI uses a pluggable authentication model, so that it is not dependent on any particular identity or mode of authenticating.
- UPI is interoperable, so much so that retail customers can conduct transactions on their accounts at Bank A from inside the mobile banking app of Bank B. Users can use familiar BigTech interfaces to make payments, so long as the interfaces are linked to UPI member banks. (Google Pay operates a widely used interface over UPI; WhatsApp, with over 400 million Indian users, is testing peer-to-peer payments over UPI).
- India licensed payment banks, including India Post, Paytm (a digital wallet and online platform), and private telecom companies to expand access to payments. These banks are narrow banks in that they must invest their deposits in government bills, certificates of deposit (CDs), or commercial paper.
- In a recent pilot, UPI was connected with Singapore's network for electronic transfers to test cross-border payments.
- UPI is regulated by the Reserve Bank of India.

The India Stack has had its problems. Press investigations showed that the security around Aadhaar data was weak. The Supreme Court rightly worried about privacy. The bill that the Indian government has drafted in response has a worrisome lack of checks and balances on the government's ability to access individual data. Nevertheless, as India responds to these challenges, it is worth studying this public-private partnership.

**Note:* This box draws heavily from "The Design of Digital Infrastructure: Lessons from India" by Derryl D'Silva, Zuzana Filková, Frank Packer and Siddharth Tiwari, BIS Working Paper 106, December 2019 and "India Stack-Digital Infrastructure as Public Good", Vivek Raghavan, Sanjay Jain, Pramod Varma, Communications of the ACM, November 2019, Vol. 62 No. 11, Pages 76-81.

**Note:* QR stands for Quick Response, and a QR code is the machine-readable optical label (matrix barcode) that contains information about the item to which it is attached.

messaging standard that has been promoted through the Bank for International Settlements Committee on Payments and Market Infrastructures.[5] Such a model of collaboration can be used to great effect.

TOKEN-BASED SYSTEMS

In parallel with efforts to improve the current system, further reaching technological advances have opened up the potential for a fundamental shift in the monetary architecture from account-based money back toward token-based money. Analogous to paper currency but with much greater scope and efficiency, digital tokens can be transferred from peer to peer within a decentralized network of participants. Payments can be made and settled bilaterally with no need to find a chain of interlinked intermediary balance sheets, regardless of the geographic proximity of the sender and receiver. Distributed ledger technologies (DLTs) also offer a potential realization of money as an historical ledger of all transactions, as described in 1998 by Narayana Kocherlakota in "Money is Memory." But the prospect of token-based digital currencies, even if safe and effective for making payments, opens up a host of other potential concerns and thus a range of policy considerations for central banks.

A key policy objective is to increase the efficiency of the payment system while safeguarding (if not also improving) monetary policy transmission, financial stability, financial inclusion, investor protection, privacy, tax compliance, and the legality of payments.[6] These goals entail complex policy choices, as the tradeoffs span several dimensions in the policy space.

Users who are segregated into separate, closed payment networks will not benefit from the efficiency arising from network effects—of being part of a large and open community of users with whom they can transact easily and at low cost. Segregated networks are "walled gardens" that run counter to the spirit of money as a social convention.

Network effects are likely to be particularly strong when payment services are provided by BigTechs—that is, large companies with established technology platforms[7]—that bundle other digital services using their existing businesses in e-commerce, social media, or search. The data generated by existing platforms could amplify network effects resulting in a data-network-activities (DNA) loop that entrenches a dominant private service provider.[8] In this way, the benefits of network effects in payments should be set against the detrimental effects of reliance on dominant private firms.

Policy responses may take two broad forms. The first is to attempt to apply existing financial regulations to new entrants, to ensure that they are not simply engaging in regulatory arbitrage. Here, of course, the challenge is to provide a balance between providing a level playing field with existing players and leaving scope for competition and innovation. In addition, as new tech entrants come onto the scene, it will be important to be prepared, with both traditional tools from industrial organization and emerging tools such as mandated interoperability, to regulate dominant firms. These must be reinforced with conduct regulations against illicit activities, and with regulations on the acquisition, use, and dissemination of data. Parameters for such policies are set out below. A second possible policy response is to delineate a role for the public sector in providing the core, foundational infrastructure so as to promote a level playing field that nevertheless reaps the benefits of network effects.

The evolution of the internet is a good illustration of the second approach. The internet ("interconnected networks") has its origin in academic and military computer networks. The flowering of the modern internet was made possible by the common adoption of standards, such as the TCP/IP protocol, and the convention governing email addresses that

5 The adoption of ISO 20022, which is an international standard for electronic data interchange between financial institutions, is helping to improve technical compatibility between wholesale payment systems. SWIFT (a global provider of financial messaging services) plans to migrate all cross-border payments sent over its network to ISO 20022 by 2025. (https://www.bis.org/publ/qtrpdf/r_qt2003f.htm)

6 The G7 Working Group on Stablecoins (2019) provides a more comprehensive summary of the challenges and risks.

7 BigTech firms include Alibaba, Amazon, Apple, Baidu, eBay, Facebook, Google, Microsoft, and Tencent. For an informative discussion of the issues related to BigTech, see Financial Stability Board (2019).

8 The economics of the DNA loop is developed in BIS (2019). The importance of addressing the economics of data is further developed in Carstens (2019b).

arose from public policy choices through nonprofit public agencies.[9] The analogue for payment systems would be a core infrastructure provided by the public sector, based on common addressing and messaging standards combined with interoperable "open APIs" that prevent the building of private walled gardens of closed networks. Common addressing standards and open APIs promote network benefits while preserving fair conditions.

The remainder of this report is devoted to a high-level discussion of selected policy options and related issues under the basic rubrics described above.

9 TCP/IP stands for Transmission Control Protocol and Internet Protocol.

2. POLICIES REGARDING COMPLIANT DIGITAL CURRENCIES AND PAYMENT SERVICE PROVIDERS

A policy of requiring new payment technology providers to meet at least existing functional outcome standards seems obvious. As new payment methods appear, relevant regulatory frameworks need to be mapped and checked for coverage of all critical standards, including investor protection rules, Committee on Payments and Market Infrastructures-International Organization of Securities Commissions (CPMI-IOSCO) Principles for financial market infrastructure (PFMI), and various standards for the legality of transactions (for example, with respect to anti-money laundering and countering the financing of terrorism[10]), among other relevant regulations. Wherever there are regulatory gaps or difficult intersections of regulatory responsibilities, appropriate action can be taken. In this area, the main official sector concern is as much policy execution as the choice of a policy stance. Because some new payment technologies cut across traditional lines of jurisdictional responsibility, coordination among regulators, domestically and internationally, will be necessary.

Regulatory safeguards to accompany innovative payment services are needed, both for traditional account-based payment service providers (such as Alipay and WeChat Pay, in China) and for privately issued digital currencies such as Libra. Private payment service providers that hold customer balances as bank deposits may introduce systemic risks in the face of concerted redemptions by customers. To reduce potential risks of runs on money market funds, the authorities in China introduced a cap on instant redemptions from them, as well as a 100 percent reserve requirement. From January 2019, BigTech payment service providers have been required to keep 100 percent of customer balances in a reserve account with the central bank. In addition, BigTechs are required to clear payments on a newly created share-holding clearing house, NetsUnion Clearing.

More generally, the extent to which the official and private sectors provide key aspects of payments can vary. Consider the four different approaches toward digital currency that are used to effect payments: Private Stablecoins, General Central Bank Digital Currency, Synthetic Central Bank Digital Currency, and Wholesale Central Bank Digital Currency.

PRIVATE STABLECOINS

A stablecoin is a digital currency. The entity issuing a stablecoin attempts to reduce its price volatility by pegging its value to some external asset or basket of assets like fiat money or exchange-traded commodities. The risks and issues to be addressed by regulation of private sector stablecoins are as follows.

a. *Legal risk.*

Stablecoins and the underlying technical arrangements may vary considerably. Legal characterizations depend on the particular design. Key features would be whether the stablecoins have an identified issuer or not, whether they are linked to assets or funds outside the platform or not, and whether the underlying arrangement is

10 See Financial Action Task Force (2019).

permissionless or permission-based or not. An important legal determination is whether a stablecoin is to be categorized as a contractual claim or a property right. The legal characterization of stablecoins is especially critical in cross-jurisdictional contexts, because of the importance of the ability to determine, case by case, which jurisdiction's laws apply, and which jurisdiction's courts have competency. Eventually, regulators must decide what the property framework should be, and ensure that they have the legal powers necessary to enforce that framework.

b. *Consumer and investor protection.*

Given the complexity and novelty of digital assets, consumers and investors might not fully comprehend the risks. These risks are related to product and services safety (including security and fraud protection), the provision of accurate and relevant information to consumers, and deceptive marketing and other undesirable practices.

c. *Competition.*

When stablecoins achieve sufficient scale, they may pose challenges for competition and antitrust policies, especially if a global stablecoin arrangement could lead to market concentration. Global stablecoin providers may become natural monopolies due to the strong network effects, the large fixed costs needed to establish operations at scale, and the exponential benefits of access to data. In addition, firms may be able to extend their monopoly position in related sectors that can leverage the same datasets. Clearly, many questions about data sharing and data privacy parallel the broader set of issues surrounding tech today. A partial remedy might be to mandate data sharing based on individual consent and to require interoperability through open APIs (see for example, the intent behind European Payment Services Directive 2 or the India Stack, described in box 1).

d. *Data privacy.*

As data custodians, stablecoin providers, especially bigtech providers, should comply with notice, consent, protection, data breach, and data-sharing standards. Data policies are difficult to coordinate across borders, especially with disparate laws and regulations across regions, as well as differing views on data protection and privacy. Improved international cooperation is essential.

e. *Robustness to speculative attack.*

The long history of fixed exchange rate regimes suggests that even if a peg has been maintained for many years, it can end up being taken down by an attack of sufficient magnitude. Though most of today's stablecoins advertise themselves as being fully backed by risk-free securities, in fact, even many of the most credible such stablecoins rely on commercial paper that might become illiquid in a crisis (see box 2 on Tether and box 3 on Libra).

In conclusion, private stablecoins are an important development, but it is unclear if, in the long run, they can actually remain stable in all plausible contingencies without some form of government backstop.

BOX 2. TETHER

Tether is a privately issued stablecoin whose history points to the need for a clear regulatory framework for private digital currencies.

A stablecoin is a cryptocurrency whose price is the same or approximately the same as that of a native fiat currency. This could be arranged, for example, through a promise of convertibility against the fiat currency based on backing assets such as bank deposits. Stablecoins could be issued by commercial banks, Fintech firms, or other entities.

At present, Tether, with a market cap as of mid-June 2020 of over US$9 billion, is by far the most popular stablecoin, accounting for about 95 percent of the exchange volume and about 81 percent of the market capitalization of all stablecoins, according to Bullmann, Klemm, and Pinna (2019). Although the price of a tether has usually

been around one US dollar*, concerns have been raised about whether tethers can be reliably redeemed for one dollar each.

In 2019, a legal action by the New York State Attorney General found that Tether is backed only in part by bank deposits and in part by a large risky loan to an affiliated exchange-services provider.* The Attorney General, Letitia James, emphasized the associated lack of disclosure and risk of loss to investors. In an April 30, 2019, affidavit on this matter, the general counsel of Tether admitted that Tether was indeed only partly backed by cash reserves. He wrote that, "As of the date I am signing this affidavit, Tether has cash and cash equivalents (short-term securities) on hand totaling approximately $2.1 billion, representing approximately 74 percent of the current outstanding tethers."

Empirical research by Griffin and Shams (2019) examines the hypothesis that Tether's issuer manipulates cryptocurrency prices. Under this hypothesis, "When prices are falling, the Tether creators can convert their large Tether supply into Bitcoin in a way that pushes Bitcoin up and then sell some Bitcoin back into dollars in a venue with less price impact to replenish Tether reserves." They find that "Our results are generally consistent with Tether being printed unbacked and pushed out onto the market, which can leave an inflationary effect on asset prices." In a response to these concerns, Tether wrote in November 2019 that "All Tether tokens are fully backed by reserves and are issued pursuant to market demand, and not for the purpose of controlling the pricing of crypto assets."

**Note:* There is also a version of tether pegged to the euro called the Euro Tether (EURT), which, however, is much less popular than the tether pegged to the US dollar (USDT).

**Note:* Letitia James, Attorney General of the State of New York, vs. Tether Holdings Limited. Index No. 450545/2019. Supreme Court of the State of New York, County of New York.

BOX 3. LIBRA

Without question, the 2019 entrance of tech giant Facebook into the digital currency space with its Libra project served as a wakeup call to central banks on the need for digital currency regulation. Since then, the pace of discussion and analysis has picked up markedly, pushed forward in part by Switzerland's Financial Market Supervisory Authority (FINMA)—where Libra has applied for regulation—to consult closely with major central banks. This led to a reformulation by Libra in an April 2020 white paper (https://libra.org/en-US/white-paper/), in order to better satisfy the concerns of regulators. Important changes to the most recent formulation include that Libra will now offer a variety of single-currency stablecoins, ensure stronger backing to the Libra Reserve, and abandon the original goal of transitioning to a permissionless digital currency.

From a technology perspective, it is useful to contrast Libra with the USD coin issued by Circle, one of the most important existing stablecoins (with a June 2020 market cap of US$730 million).* Both the Circle dollar and Libra dollar would be redeemable for one US dollar. Circle's tokens, however, may be thought of as an application built on top of Ethereum, which can be viewed as a programming language for smart contracts. Libra, by contrast, is vertically integrated, with Facebook's independent subsidiary Novi (formerly Calibra) managing digital wallets, and a new Libra Foundation overseeing both the underlying programming language and the application. In principle, like Ethereum, the programming language underlying Libra could have many other applications, for example, in managing data.

A fundamental issue for all stablecoins is their resilience to conventional speculative attacks, analogous to attacks on fixed exchange rates. Even if the stablecoins are much closer to "narrow banks" than conventional bank accounts, they can still be vulnerable in the same way as money market funds. It is quite possible that in the long run, stablecoin issuers will need a government guarantee.

**Note:* Circle introduced its co-called USD Coin, or USDC, on September 26, 2018, as a way to tokenize US dollars and to use those dollars over public blockchains on the internet (https://www.circle.com/blog/introducing-usd-coin).

For small open economies, a more basic issue is that non-native digital currencies may disrupt domestic monetary policy transmission, even given full compliance with conventional payment system standards. These issues, of course, have much in common with dollarization, a long-standing issue in many emerging markets and developing economies that is exacerbated by the potential entrance of cross-border stablecoins. Perhaps more concerning in this regard would be a token-based central bank digital currency issued by a credible central bank. That is what we turn to next.

DIRECT CENTRAL BANK DIGITAL CURRENCY

The provision of the core, foundational infrastructure is a natural fit for a central bank through its role in providing settlement accounts for commercial banks and other payment services providers. In this context, a direct central bank digital currency (CBDC) may find a rationale when the CBDC can enhance the effectiveness of that infrastructure.

Appropriate policies for the introduction of a general CBDC rest on an in-depth, case-by-case analysis. The risks and potential benefits relative to alternative approaches are large. In some jurisdictions, the existence of a net benefit will be difficult to judge without a deep and painstaking analysis. The dimensions to be considered include the following:

a. *Permissioned or permissionless?*

Permissioned currencies, of course, amount to using better data processing methods for enabling retail customers, and not just banks and financial institutions, to hold electronic deposits at the central bank. This need not be an all-or-nothing decision. For example, just as many countries have postal savings systems, it might be possible to allow retail depositors to hold deposits with more savings account (rather than checking account) characteristics. Such accounts need not be offered by the central bank. For example, in the United States, "Treasury Direct" accounts allow American citizens to buy Treasuries (from one week to 30 years) in amounts of US $100 to US $5million for any single auction, paying virtually zero transactions costs and receiving full market interest rates. Moreover, any individual can make transfers to any other individual holding an account. This system has already been in place for more than a decade and has proven to be quite robust.

b. *Payment efficiency.*

If CBDC involves tokens, then the cost efficiency, facility, and speed of CBDC payments would likely be attractive relative to most alternatives, at least assuming (as we do) continued evolution of the technology. Assuming that CBDC payments are based on real-time gross settlement, however, the required amount of pre-funded high-quality liquid asset (HQLA) balances for liquidity purposes could increase substantially over that needed for deferred net settlement payment systems that are based on bank deposits. Among other associated concerns, the central bank might need to expand its balance sheet to accommodate the greater extent of pre-funding.

c. *Financial stability.*

One concern over a generally available CBDC has been the risk of a run to CBDC, especially during times of funding stress in the banking system, when a flight to safety from commercial bank deposits to central bank liabilities might trigger broader financial

instability.[11] While higher deposit rates on commercial bank deposits would make commercial bank deposits attractive to retail depositors during normal times, a concern is whether differentiated remuneration of commercial bank deposits and central bank liabilities would be sufficient to preclude a run from bank deposits during stressed times. Access to physical cash has not led to such generalized runs, but an open question is whether the general availability of an electronic form of the central bank liabilities renders the run scenario more likely. These concerns should be weighed against potential advantages of CBDCs.

d. *Commercial footprint.*

Relatedly, the central bank's lender of last resort facilities, which recycle funding inflows to the central bank back to commercial banks, would increase the central bank's commercial footprint on the payment system, greatly enlarging the role of the central bank in financial intermediation. In extreme cases, the central bank could become a nearly monopolistic portal to the entire payment system, directly facing almost every user in the economy down to consumers and small and medium-sized enterprises and handling the vast majority of domestic payment flows.

As noted by Brainard (2019) and Carstens (2019a), the risks and operational costs for the central bank could be daunting. The economic (and possibly political) power concentrated in the central bank would also be formidable. There are few existing models of broad-economy services provided directly to users by central banks.

Although official-sector monopolies are somewhat common in other industries such as electric power generation, postal services, tax collection, and mass transit, they represent a wide range of cost-effectiveness and service quality. This raises the potential for a link between the central bank's monetary policy independence and its reputation among voting consumers for the quality of its CBDC services. Further below, we consider public-private hybrid forms of CBDC that mitigate some of the footprint concerns of a direct general-purpose CBDC.

e. *Disruption of legacy bank franchises.*

Large and profitable payments-related banking franchises could be impacted, in both volumes and markups (Vives 2019). For example, credit card volumes, interchange fees, payment transaction fees, and deposit interest margins could be seriously affected. This could weaken the viability of banks that rely heavily on these forms of rent taking. The costs of disruption are to be weighed against the goal of improving competition in payment-related services. Concerns about disrupting banking franchises are not specific to CBDCs and are likely to arise with any efficient and open upgrade of the payment system. The Sveriges Riksbank (2018) estimates a relatively minor impact of adoption of its digital currency, the e-krona, on bank funding costs, and a correspondingly minor increase in bank lending rates. Some theoretical analyses show no significant declines in the volume of bank deposits, largely because banks would react to the competitive pressures induced by a CBDC by increasing their deposit interest rates.[12]

f. *Privacy and data protection.*

Depending on the design, the central bank could become a repository for economy-wide transaction-level data. The responsibilities of the central bank for protecting privacy and data, including from other arms of the government, could be onerous.

g. *Data and innovation.*

The data generated by payments can be valuable for the individual users (data analytics), and to financial service providers when creating new products. Central banks may not be in the best position to understand what data need to be collected and how to disseminate them, keeping issues of customer consent, privacy, and data ownership in mind. Similarly, new innovative financial products may require creativity in data collection, and a willingness for the central bank to adapt its data collection processes in specific cases. On both data and innovation, central banks would need to develop new structures to interface with the private sector so as to determine what changes to push. For instance, the Bank of England and the Monetary

11 The relevant literature includes BIS (2018), Barrdear and Kumhof (2016), Davoodalhosseini (2018), Meaning, Dyson, Barker, and Clayton (2018), Pfister (2017), and Zhu and Hendry (2019).

12 See Andolfatto (2018) and Barrdear and Kumhof (2016).

Authority of Singapore have regulatory "sandboxes," which facilitate private sector innovation and experimentation (sometimes with regulatory dispensations), carefully watched by the regulatory authorities.

h. *Operational risks.*

Operational risks for CBDC include cyber attacks and accidental software outages. There is potential for the risks to grow exponentially as any given token or protocol becomes more valuable and important in the international financial system. The US government's Information Technology Laboratory (2015) suggests a five-year timeline to check hardness of systems. As Narula (2017) notes, even large cryptocurrencies can have flaws in their design. There is a constant arms race between new code-breaking algorithms and new codes. Indeed, the early cryptographic standard SHA-1[13] is no longer used, and several rounds of improved standards have been implemented. One of Bitcoin's great strengths, and a major reason for its enduring market leadership among cryptocurrencies, is that it has been widely tested for a long time. Even so, as Budish (2018) shows, a malicious state actor unconcerned with losing a few billion dollars could potentially wreak havoc on the system. The basic logic of his proof is that the cost of the attack is equal to the flow going through the system, but the damage being done is potentially equal to the stock. Thus, if Bitcoin ever underpinned a large enough fraction of the system, there could be major vulnerabilities.

i. *Monetary policy transmission.*

In general, an increase in the efficiency of the payment system would increase the speed and extent of passthrough of policy rates into various private sector interest rates.[14] Indeed, the central bank has the possibility of offering interest rates (typically negative) on CBDCs. If the central bank rules out negative interest rates on CBDCs, however, then the introduction of a CBDC would likely place an effective floor of zero on central bank deposit rates.[15]

j. *Financial inclusion.*

A CBDC can increase or reduce financial inclusion, depending on the degree to which "unbanked" consumers rely on physical cash, which could be driven out by mass adoption of the CBDC. This calls for a case-by-case analysis (Andolfatto 2018; Sveriges Riksbank 2018). Of course, this side effect can be largely mitigated by taking strong steps to promote financial inclusion (Rogoff, 2016).

k. *AML-CFT-tax compliance.*

Without effective public-private partnership, the central bank could also become responsible for monitoring transaction-level anti-money laundering/combating the financing of terrorism (AML-CFT) tax compliance. This could be viewed as more attractive in some countries than in others.

l. *Digital dollarization.*

A stable digital token currency offered by a reserve country central bank would be a formidable attraction to citizens in small open economies, especially underdeveloped ones. In addition to the issues raised by dominant private stablecoins, there are additional concerns raised by data collected on a country's citizenry by a foreign central bank.

INDIRECT CBDC OR HYBRID CBDC

Concerns associated with the size of the central bank's footprint arising from direct CBDC can be mitigated by partially insulating the central bank from general users. One version of this insulation is a second tier of narrow payments banks (see the India Stack described in box 1, and Kumhof and Noone [2018]). There are a number of variants.

One variant would be indirect CBDC, by which technology firms or conventional banks could provide customers with synthetic CBDCs that are fully backed by segregated central bank deposits. Another would be an approach by which narrow payments banks invest customer deposits exclusively in central bank

13 SHA-1, which stands for Secure Hash Algorithm-1, was designed by the US National Security Agency for information processing. It is no longer considered safe.

14 See Meaning et al. (2018).

15 See OMFIF and IMB (2019).

deposits. This is equivalent, from a financial accounts perspective, to a direct CBDC, but leaves scope for "tiered remuneration" of deposits (Kumhof and Noone 2018; Bindseil 2019). Customers would then be able to make payments with narrow bank deposits, whether in tokenized form or account-based form.[16]

In all cases, the private sector rather than the central bank would be responsible for onboarding CBDC users to application program interfaces and for the distribution and exchange of the CBDC. Maintaining interoperability, and thus fungibility, is likely to be crucial to the design. A public-private approach seems likely for the CBDC to be introduced in China (see box 4 on the People's Bank of China's Digital Currency Electronic Payment), where WeChat Pay and Alipay already offer payment services in a form of money that is backed by central bank deposits. These two private mobile payment services, however, are each "closed payment systems" that are not directly fungible with each other.

16 See, also, the descriptions of "synthetic CBDC" in Adrian and Mancini-Griffoli (2019).

BOX 4. CHINA'S NASCENT CENTRAL BANK DIGITAL CURRENCY

Digital Currency Electronic Payment (DC/EP) is a payment arrangement for digital renminbi (RMB), also called e-CNY (or e-yuan). The e-CNY is a value-based, semi-account-based and account-based hybrid payment instrument, with legal tender status and loosely coupled account linkage, issued by the People's Bank of China (PBC), operated and exchanged by the authorized operators including commercial banks, payment service providers, and other private sector institutions.

DC/EP is the payment system supporting the issuance and exchange of e-CNY, which is the digital version of RMB. The e-CNY is the fiat currency in China and equivalent to the paper/plastic/coin version of RMB. Therefore, it is different from Bitcoin and Libra, both of which are tradable financial assets.

A two-tiered system comprising the PBC and commercial institutions serving as operating agencies would be a suitable approach for CBDC operation in China. A two-tiered model will allow more effective use of existing business resources, human resources, and technologies, and promote innovation and competition through market-driven development, without imposing any prescriptive technology path in advance. It is different from the decentralized issuance of crypto assets.

The PBC has adopted a hybrid CBDC model, which is an intermediate solution providing for direct claims on the central bank, with real-time payments to be handled by intermediaries. The general public could exchange e-CNY from the authorized operators, who could exchange the same amount of e-CNY from the central bank. Consumers have a direct claim on the central bank. It would not change the current creditor-debtor relationships in currency circulation.

In line with the principles of a two-tiered system, M0* substitution, and controllable anonymity, the DC/EP project has completed the architecture design, technical standards formulation, system development, and interoperability test. The PBC will prudently select appropriate use cases and initiate pilots in several cities. Based on the progress of the pilot run, PBC will continuously enhance the performance of DC/EP to prepare for the future introduction of e-CNY. All the authorized operators have formulated an exit plan as part of the pilot program, similar to a "sandbox" model, to ensure that the process is reversible.

The DC/EP system will not change the existing currency circulation system and two-tier account structure or create competition with commercial banks in the savings market. In other words, a two-tier e-CNY would not increase bank reliance

**Note:* M0 is the total of all physical currency including coinage

on interbank borrowing or affect their lending capacities, so disintermediation can be avoided. Further, since it will not affect the existing monetary policy transmission mechanism or intensify procyclicality in different stress scenarios, issuing e-CNY would not have any negative impact on how the real economy operates. Finally, the model will make currency operation more cost-effective, improve money circulation efficiency, and ultimately enhance the user-friendliness and security of payment services. Also, endorsement by the central bank would smooth out potential spikes in consumer demand for the crypto assets.

Defined as a substitution of M0, the e-CNY will be subject to existing cash management, anti-money laundering, and counter-terrorist financing regulations. The PBC will require relevant organizations to report large-value and suspicious transactions to clamp down on money laundering activities. To avoid the "crowding out" effect on bank deposits, arbitrage trading and a rise in procyclicality, the use of the e-CNY is likely to be limited to small retail transactions through setting maximum daily and yearly limits and introducing policies that e-CNY conversions exceeding a certain amount can only be processed by appointment. If necessary, a multitier fee system may be introduced, that is, small-sum and low-frequency transactions to be processed free of charge, and service fees to be charged on large-sum or high-frequency transactions to increase the exchange cost and system friction.

The e-CNY will be introduced to substitute M0, meaning that no interest will be paid. Therefore, it will not cause disintermediation or lead to a rise in inflationary expectations, and neither will it have any significant impact on the current monetary and financial systems or the real economy.

The e-CNY will be used on a controllable anonymity basis; without third-party anonymity, the CBDC transactions may jeopardize personal data and privacy, but complete third-party anonymity may encourage criminal activities such as tax evasion, terrorist financing, and money laundering. The only way to strike a balance between the two is to keep the degree of anonymity within a controllable range, namely, a pseudonym mechanism that discloses transaction data in full scale only to the PBC as the sole third party. This would allow the central bank to keep track of necessary data to implement prudential regulation and crack down on money laundering and other criminal offenses.

Legally, e-CNY is a value-based, semi-account-based and account-based hybrid payment instrument, which could be categorized as property, and is bound by property law. The e-CNY could be loosely coupled with bank accounts, and does not rely on bank accounts for fund transfer. Therefore, from the perspective of settlement finality, the settlement is completed at the very moment the payment is completed, and finality confirmation by the real-time gross settlement system is no longer required. For small merchants, the working capital turnover efficiency could be improved.

With the property characterization and the loosely coupled account linkage, e-CNY could provide functions that e-wallets cannot, such as offline payment functions. With the above characteristics, e-CNY can load smart contracts that serve currency functions such as conditional payment and scheduled payment.

Due to e-CNY's property characterization and the loosely coupled account linkage, the general public could apply for digital wallets without opening a bank account. Therefore, the issuance of e-CNY and offline payment function would enable the underbanked population in poor and remote areas with poor telecom network coverage to enjoy basic financial services, improving financial inclusion.

The authors of this report and the G30 are grateful to the People's Bank of China for contributing this box on the current state of play of China's Central Bank Digital Currency project. Importantly, the analysis illustrates some of the considerations involved in introducing a CBDC that will enhance the payments system rather than replace it, and without catalyzing rapid disintermediation. Also notable is the prospect of using the CBDC to promote financial inclusion, as well as for achieving one possible form of controlled anonymity, in which digital token transactions can be made private to all except the central bank.

OMFIF and IMB (2019) indicate a degree of support among central bankers for the public-private partnership approach.

WHOLESALE CBDCS

Account-based central bank digital currencies that are designed for the exclusive use of regulated financial institutions for "wholesale" (interbank) purposes have long existed in the form of conventional central bank deposits. Recently, tokenized wholesale CBDCs have been under development for various specific applications involving large-value payment systems, such as the settlement of large securities trades (CPMI 2017). For example, as part of their Jasper-Ubin projects, the Bank of Canada and the Monetary Authority of Singapore have tested the use of token-based CBDCs for cross-border wholesale settlements. The Hong Kong Monetary Authority and the Bank of Thailand have cooperated in a similar way. The private sector, for example, JPMorgan Coin and Fnality, has also proposed wholesale stablecoins and other substitutes for large-value payments.

For wholesale payments, settlement liquidity is particularly important. For large-value payment systems that transact in real time—so-called real time gross settlement systems (RTGS)—the associated cash-in-advance requirements can cause inefficient delays and possible gridlocks in payments. In large-value payment systems where the throughput volume of payments is large relative to cash balances, settlement liquidity emerges as a key source of potential inefficiency. A central bank could choose, for example, to provide overdrafts to payment system participants so as to allow high payment volumes with less pre-funded liquidity.

Given the nature of the applications, the case for tokenized wholesale CBDCs seems to rest mainly on "plumbing" considerations, including technology setup costs; operational and cyber resilience; speed of settlement; and "HQLA drag," meaning the average and peak quantities of central bank deposits, tokenized CBDCs, and other forms of high-quality liquid assets required to process or collateralize a given amount of transactions of a given type. The CBDC token technology itself does not mitigate settlement liquidity requirements, and the adoption of a tokenized CBDC technology does not eliminate, and could even exacerbate, the need for central bank provision of daylight overdrafts. Equally, CBDCs could be made compatible with central bank settlement liquidity. In this respect, the technology is somewhat tangential to the underlying economics of settlement liquidity.

Because they are likely to be restricted largely to the same sets of firms that currently use central bank deposits, wholesale CBDCs do not raise the tricky footprint issues associated with general CBDCs.

Apart from these approaches to introducing digital currencies domestically, central banks will also have to consider whether a cooperative effort to improve cross-border payments may be warranted, as with the Hong Kong Monetary Authority-Bank of Thailand project, and what they might do within existing payment frameworks short of introducing a digital currency.

COORDINATING THE INTRODUCTION OF GLOBAL OFFICIAL-SECTOR STABLECOINS

Carney (2019) has raised the question of whether a globally coordinated "systemic hegemonic currency" could dampen the spillover shocks associated with the dominance of the US dollar as a reserve currency. A systemic hegemonic currency could, for example, be a stablecoin backed by a basket of deposits at different central banks. It is possible that such a stablecoin could be valuable for cross-border payments, serving a function similar to that offered in the private sector by Ripple, a real-time gross settlement system, currency exchange, and remittance network whose digital currency, XRP, leapfrogs slow and expensive correspondent banking.

If such a global currency were to be heavily used, however, it could lead to monetary-policy spillover costs (Mundell 1961) and efficiency losses associated with competing payment network externalities (Brunnermeier, James, and Landau 2019). Payment settlement chains could be lengthened. To the extent that a systemic hegemonic currency would need to be supplied elastically, central banks could face significant coordination costs, given their different respective monetary conditions. Given the challenges the euro has faced, and the difficulty of having transnational

money without a transnational fiscal and regulatory authority, it is difficult at this point to see how a global currency could evolve digitally when it has not yet happened with the existing system. Nevertheless, the externalities posed by digital currencies may prove so significant that previously unthinkable levels of international coordination become possible.

UPGRADE TO FASTER AND MORE OPEN BANK ACCOUNT-BASED PAYMENTS

Banks, central banks, and payment system utilities have been upgrading the speed and times of availability of conventional bank account-based payment systems (CPMI 2016). This has been especially useful for retail applications (Bech, Shimizu, and Wong 2017; Hartmann et al. 2017). The global standard for a fast payment system is near real-time availability of the funds by payees on a 24/7 basis.

Currently, at least 45 jurisdictions have fast retail payment systems, and this number is projected to approach 60 in the near future. Notably, not all of the countries that have led these initiatives have advanced economies. Indeed, developing economies such as India have been at the forefront of developing retail payment systems that place interoperability among competitive payment service providers as a key policy objective (see box 1).

In the United States, where fast payments are not yet broadly available, the private sector Real-Time Payments (RTP) system came online in 2020. The Federal Reserve Board of Governors (2019) has projected that the Fed's own fast payment system, FedNow, will become available in 2023 or 2024.

Examples of fast payment systems that are already popular include the Korean Electronic Banking System (established in 2001), the Bank of Mexico's Sistema de Pagos Electrónicos Interbancarios, Swish (a private mobile payment system available in Sweden), and the United Kingdom's nonprofit utility known as Faster Payments. In late 2018, the European Central Bank launched TARGET Instant Payment Settlement (TIPS), based on the SEPA[17] Instant Credit Transfer platform, which offers 24/7 fast payments among participating European banks.

17 SEPA stands for single euro payments area.

3. AN APPROACH TO EVALUATING THE POLICY OPTIONS

The potential tokenization of a currency is potentially the most radical disruption of the payment system since the advent of bank intermediation. Nevertheless, it should be understood that even if technology is the impetus for this prospective disruption, the official sector ultimately controls the system. Even if governments have been relatively passive in the early days of cryptocurrencies and other digital payment innovations, they have huge scope to shape events. The often-stated phrase that money is merely a social convention ignores the giant footprint, and interests, of the state. Governments have enormous influence over what gets used as currency, at least in large parts of the economy, and at the core of the financial system. For example, a government can require that its own currency be used to pay taxes, and it can use government-issued currency to pay employees and suppliers. This already gives the government a huge base from which to establish network effects. Beyond these advantages, the government can create a broad swath of regulations that inhibit or even prohibit competitors.

Thus, the libertarian view that a superior private sector currency (such as a cryptocurrency) could somehow supplant a government currency is utterly naïve. The long history of currency shows that while the private sector may innovate, in due time the government regulates and appropriates.[18] Currency competition between the private sector and the public sector is never a level playing field.

Nevertheless, tokenization poses radical potential disruption to the long-standing two-tier payment system (with central banks and banks) in a way that previous advances in transactions technologies (such as debit cards, credit cards, electronic transfers, and smartphones) have not. The advent of token-based digital money has expanded the policy options by allowing peer-to-peer transfers of digital tokens within the network of payment system participants, definitely without banks and potentially without central banks. This presents far-reaching opportunities for greater efficiency and speed, and for lower costs, but it also necessitates a more careful consideration of the tradeoffs arising from the economics of data and the potential for entrenched private players to unduly exploit market power.

Policy responses can be grouped into three categories. First, the existing rules and regulations governing traditional financial firms should be applied to the new tech-based firms offering financial services, with the general principal of "same animal, same cage." To qualify for differential treatment, tech-based payment mechanisms will need to demonstrate a use-based argument for differential treatment, where the mechanism is not simply attempting regulatory arbitrage. Second, just as in the banking sector, it will be important to develop and implement regulations to mitigate a range of adverse effects, including those associated with conventional market dominance as well as new-age data monopolies. Third, the public sector should play a more active role in providing the

18 See Rogoff (2016).

core, foundational infrastructure, so as to promote equal conditions that nevertheless reap the benefits of network effects, while ensuring legal and regulatory compliance, including with AML restrictions.

One might argue that developing economies that lack legacy infrastructure are best placed to leapfrog existing payment architectures and the associated vested interests. As mentioned, India's efforts to build its digital public infrastructure has attracted much interest. However, there are many pitfalls, as well, from failure to employ a sufficiently robust technology to corruption, that present challenges.

CONCLUSIONS

The potential for tokenization of payment systems using blockchain has evolved to the point where governments and financial authorities can no longer afford to be passive bystanders. Their actions and decisions, whether to extend existing regulation to tech firms, or even to issue their own digital currencies, will play a major role in the evolution of the system. A failure to be proactive could result in an extremely suboptimal development path, for example a failure to establish a satisfactory level of interoperability between different systems. There are difficult issues relating to technology and international cooperation that need to be tackled. It will be a challenge to align interests. For example, the United States might resist transitions that diminish the international role of the dollar, while other regions might resist transitions that appear to strengthen it. There may also be different views on standards for information sharing and data protection.

Recognizing these challenges and uncertainties, we make the following recommendations:

1. Central Banks and Finance Ministries must play an active leadership role in setting standards and providing public infrastructure for payments, which cannot be left to market forces alone.

2. New technologies may require a sufficiently long phase-in period in order to be tested fully. Multiple payment alternatives should be introduced so that the payments system gains a measure of resilience and includes adequate competition.

3. Existing technologies that allow faster retail payments, which drastically increase competition and lower costs to businesses and consumers, should be implemented more widely.

4. Policy consideration of a direct (full retail) CBDC should take into account the possible concentration of risk, disintermediation of traditional lending institutions, and excessive government control of credit allocation, which would be counterproductive in today's diverse modern economies.

5. Before implementing any type of CBDC, its impact on various aspects of the economy should be evaluated very carefully, among them its effect on monetary policy transmission, on the safety and integrity of the financial system, and on the emergence of alternative options such as indirect/hybrid CBDCs.

6. As the payments system becomes more digital, it will be important to find a balance between the protection of individual data and privacy versus the government's imperative to enforce laws, regulations, and taxes. The issues in payments need to be examined holistically, along with other privacy concerns arising from data gathering by banks, large tech companies, and governments.

7. Importantly, the increased cross-border use of digital currencies necessitates an international framework for governing data usage and exchange.

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