

Should the United States Issue a Central Bank Digital Currency? Lessons from Abroad

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Note that this paper is not the work of an employee of the Federal Reserve Bank of Atlanta. The paper was originally presented at the Federal Reserve Bank of Atlanta's Financial Markets Conference in May 2022. The views in this document are those of the author and do not reflect the views of the Federal Reserve Bank of Atlanta or the Federal Reserve System.

Summary:

Other countries' experiences with central bank digital currency (CBDC) provide lessons for the United States. Arguments for a US CBDC are the need to provide electronic payment services to underbanked individuals, the need to provide interoperability and stability to emerging private electronic systems, and, in the case of wholesale payments systems, the possibility of improving cross-border payment services.

Key findings:

1. Introduction of retail CBDC can remedy some of the limitations of both cash and existing electronic payments arrangements.
2. Decisions regarding privacy are fundamental to the design of CBDC, and countries differ in their responses.
3. Publicly provided faster-payments services and wider access to Fedwire may be more effective routes to improved retail payment systems.

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Introduction

Right now, regulators in the United States are carefully considering the implications of a variety of innovations in payments, and in particular the issues that would be involved in adopting a central bank digital currency (CBDC). In recent months, four major reports or pronouncements have been made by US officials. Most recently, in March 2022, the White House issued an executive order on digital assets that, among other things, places “urgency on research and development of a potential United States CBDC, should issuance be deemed in the national interest.”¹ The order “encourages the Federal Reserve to continue its research, development, and assessment efforts for a U.S. CBDC” (White House 2022).

In fact, the Board of Governors of the Federal Reserve had issued a report on money and payments in January intended as “the first step in a public discussion between the Federal Reserve and stakeholders about central bank digital currencies,” outlining potential benefits and risks of CBDC and suggesting particular features that a CBDC might incorporate to “best serve the needs of the United States” (BOG 2022). Meanwhile, the Federal Reserve Bank of Boston, in conjunction with the Massachusetts Institute of Technology (MIT), issued a white paper in February outlining phase 1 of “Project Hamilton, a multiyear research project to explore the CBDC design space and gain a hands-on understanding of a CBDC’s technical challenges and opportunities.”² Finally, the interagency report on stablecoins—issued in November 2021 by the President’s Working Group on Financial Markets, the Federal Deposit Insurance Corporation, and the Office of the Comptroller of the Currency—outlined the risks involved and the regulation needed to deal with the main potential private alternative to CBDC (PWG 2021).

Despite this flurry of activity, the United States comes late to the discussion of CBDC.³ Throughout the world, governments, central banks, and regulators have been intensively researching CBDC for nearly a decade.⁴ Within this period, public interest has waxed and

¹ Exec. Order No. 14067 of March 9, 2022, 87 Fed. Reg. 14143 (March 14, 2022), <https://www.whitehouse.gov/briefing-room/presidential-actions/2022/03/09/executive-order-on-ensuring-responsible-development-of-digital-assets/>.

² See BOS/MIT (2022). In phase 1, the group “created a design for a modular, extensible transaction processing system, implemented it in two distinct architectures, and evaluated their speed, throughput, and fault tolerance.” In this initial version, “there are no intermediaries, fees, or identities outside of public keys,” although these could be added in the future. The next phase of the project will explore alternative designs and additional functionality.

³ This claim is not entirely fair. For examples of early investigations by Fed researchers, see, among others, Andolfatto (2018), Berentsen and Schar (2018), Keister and Sanches (2019), and Mills et al. (2018).

⁴ For example, see the lists at the site maintained by John Kiff—<https://kiffmeister.com/jurisdictions-where-retail-cbdc-is-being-explored/>—and by the Bank for International Settlements (Auer et al. (2020)

waned, with shifting interest in alternatives to CBDC, like stablecoins and faster payments arrangements. In particular, Facebook’s announcement of the Libra cryptocurrency proposal in 2019 focused attention and concern. But overall, the topic has evolved from study toward development and, recently, implementation.⁵

CBDC proposals come in many forms, advancing a variety of policy goals. When assessing the desirability of the introduction of CBDC, it can be extremely confusing to navigate among these proposals. Thus, it becomes useful to consider concrete examples and experience. In this article, I will focus on four countries that have been at the forefront of discussion, research, or implementation in order to help clarify possible implications of CBDC for the United States.⁶

CBDC: What and Why

We begin with definitions. The first seems pretty clear:

“A CBDC is a digital payment instrument, denominated in the national unit of account, that is a direct liability of the central bank” (Bank of Canada et al. 2020).

For example, cash (Federal Reserve notes) fits the definition in all ways except that it is physical, not electronic. Bank money (checking accounts) is not CBDC, even though it can generally be used to make electronic payments, because it is a direct liability of the bank, backed only indirectly by the bank’s holdings of central bank liabilities, as well as other assets and central bank guarantees. CBDCs must also be distinguished from *stablecoins*, digital assets provided outside the standard banking system but designed to maintain a stable value relative to the national unit of account.

The basic definition of CBDC leads to a natural question: What about central bank reserve accounts?—that is, the accounts that commercial banks hold at the Federal Reserve. Banks use these accounts to make payments to one another, and they are certainly direct electronic liabilities of the central bank. In response to the question, “Should the United States adopt a CBDC?” an easy way out would be to argue that the United States already has one. To avoid shutting the discussion down in this fashion, the Committee on Payments and Market Infrastructures at the Bank for International Settlement (BIS) provides a “negative definition”:

and updates at <https://www.bis.org/publ/work880.htm>). Also, see the recent survey by Kosse and Mattei (2022).

⁵ In fact, Finland can lay claim to the first actual implementation of a CBDC in the 1990s in the form of a smart card that accessed electronic central bank liabilities. The card was eventually privatized and then surpassed by the introduction of inexpensive bank debit cards. For more details of this interesting example, see Grym (2020).

⁶ For another study that provides an international comparison of innovative cases, see Soderberg et al. (2022).

“...it is easier to define a CBDC by highlighting what it is not: a CBDC is a digital form of central bank money that is different from balances in traditional reserve or settlement accounts” (CPMI/MC 2018).

There are two important subcategories of CBDC proposals. The first is “wholesale CBDC”—a special-purpose asset restricted to financial market payments. Were it not for their specific exclusion, central bank reserves would most resemble this category of CBDC. One of the countries in this article, Canada, has given particular attention to the possibilities for wholesale CBDC. However, to date, most international attention has been given to *general-purpose* (“retail”) CBDCs, intended to be used by the public for day-to-day payments. General-purpose CBDCs are, for example, the focus of the Fed report.

Along with these two major classifications, there are a host of other classifications to be considered: some proposals involve paying interest on the CBDC (and some envisage the possibility of negative interest). Some proposals assume that the holder interacts directly with the central bank through dedicated central bank accounts; others assume a separate institution takes on one or more of the jobs involved in managing and/or serving as custodian for customers’ digital wallets.⁷ Proposals allow wallet providers varying degrees of flexibility in designing the “end-user experience,” aggregating individual units of CBDC into accounts, and enabling their expenditure through a variety of means of validation. Some allow for offline functionality through payment cards or mobile phones. Proposals also vary in more technical ways: some employ decentralized ledgers (DLT) and/or allow for the use of smart contracts.

Given the variety of proposals, it is not too surprising that the rationales in support of introducing CBDC are equally varied. Following are some typical rationales.

The desire to improve upon cash

This set of rationales includes various perceived limitations of physical cash. Physical cash is expensive for the central bank and commercial banks to provide. Its use facilitates illegal activities including tax avoidance and money laundering. It can be stolen or lost without recourse. Surely, the argument goes, the time is ripe for an electronic replacement that avoids these downsides.

The inevitable demise of physical cash

This set of rationales, rather than focusing on the undesirable features of cash, focuses on the desirable ones: for individual users, relative to other payments methods, cash is low cost, reliable, and easy to use, and its use requires no particular set-up effort. These features are worth preserving. But payments services are subject to network externalities: the usefulness

⁷ A “digital wallet” is an arrangement enabling a customer to store and make transactions with electronic currency. The wallet may be software residing on a user’s device, or it may be an online service. When CBDC is issued in the form of tokens, a wallet is used to manage the ensemble of tokens, enabling the customer to avoid the complexities of dealing with the tokens individually.

of a payment service to one user depends on the degree to which others are also willing to accept it. As electronic payments of various sorts become more common, more individuals will find that it is no longer practical to pay in cash: businesses may stop accepting it, and customers may stop carrying it. An alternative to cash becomes necessary for those who value the particular desirable features of cash.

The needs of cash-based customers

Even now there are individuals who use cash not because they find its features particularly desirable but because they are unable to avail themselves of banking services, including the payments technologies available to bank customers. CBDC is sometimes promoted as an alternative payment arrangement that will allow for the underbanked portion of the population to enjoy the benefits of electronic arrangements. The argument is reinforced if the prospect of the disappearance of cash leaves the most vulnerable portions of the population without basic payments services.

Responses to limitations of alternative electronic arrangements

CBDC is also sometimes advocated as a way of correcting the limitations of privately provided electronic arrangements. In many countries, it is argued, the prevalence of network externalities in payment systems and the costs to customers for switching from one payments provider to another could conceivably limit the incentives of banks and other mainstream financial institutions to innovate. As a nonprofit institution, a central bank could use the development of CBDC as both a spur to innovation by competing systems and a limit to their power to extract surplus from users by reducing switching costs and lessening the pricing power of network effects.

It is possible that a well-run CBDC can serve to improve the payment system in general, helping to improve interoperability among existing electronic payment systems by providing a commonly accepted intermediate asset. Furthermore, a CBDC *may* improve financial stability by serving as a safe payment asset and refuge in financial crises, and as a disciplinary device against dodgy payment system providers.⁸

Wholesale transactions simplification

So far, the arguments have mainly applied to potential retail uses of CBDC. Some observers have also argued for the potential usefulness of CBDC in streamlining payments among financial institutions. Financial asset transfer and settlement is already carried out through electronic processes; it is conceivable that these activities could be improved if the payment asset on the other side of the transaction were a digital currency, and the safest such currency

⁸ On the other hand, the opposite argument is also made: that by speeding and easing electronic transfers out of payment providers and financial institutions, a CBDC could make runs more likely, increasing financial instability. See BIS (2021a) for various arguments.

would be one backed directly by a central bank.⁹ This improvement might be particularly important in the case of international transactions involving multiple currencies, if they were all available in the form of CBDC.

Macroeconomic policy

A final set of arguments has been mooted with respect to macroeconomic effects of a CBDC. The first of these arose in connection with the concern in recent years about the “zero lower bound” on monetary policy: the fact that negative nominal interest rates are limited by the public’s ability to hold cash. Although retail CBDC would not be necessary to break the zero lower bound (see, for example, Agarwal and Kimball 2015), negative interest rates would be easier to achieve if the public held currency in electronic form. More generally an interest-bearing CBDC might allow a monetary authority to control interest rates more effectively and to target more complex policies if warranted. On the other hand, if electronic payments became disconnected from the monetary base, then monetary policy could lose its force.¹⁰

There are two important points to note about this list. First, the very length and variety of considerations on the list makes it difficult to make a straightforward case for CBDC. In their examination of the case for CBDC, many central banks decided that while CBDCs could provide benefits along a variety of these dimensions, for each goal considered separately CBDC was not necessary; instead, there was a simpler policy available. The conclusion often came down to something like the following: “If we decide to adopt CBDC anyway, then it might also provide benefits along this dimension as well.” Thus, in advocating CBDC, it becomes important to focus on significant advantages that CBDC alone can yield.¹¹

The second important point is that much of the recent activity by central bankers may have in fact been a defensive mechanism. As noted by an official of Sweden’s Riksbank (Skingsley 2016): “For one thing, it reduces our significance for the payment system when cash is used less often.” In this respect, it is important to note the difference between central banks’ attitudes and research before and after Facebook made its Libra proposal. Before Libra,

⁹ However, see, for example, CPMI/MC (2018) for a critique of this argument.

¹⁰ Such a flight could also have an impact on seigniorage revenues. While major central banks emphasize that seigniorage revenues are not a determinant of their policies, they may be a factor for smaller countries (Kahn et al. 2022). Furthermore, in many countries, a portion of central bank profits are remitted to the government and continued profitability is a factor in ensuring central bank independence.

¹¹ Of course, it could be the case that the combination of a variety of small benefits provides sufficient motivation to adopt a CBDC even if no single benefit alone did so. The problem is that optimal design features differ greatly for various proposed use cases, so that tweaks incorporated to address one small benefit typically work against other small benefits: for example, features intended as improvements upon cash typically compromise privacy; new features for stability and interoperability frequently sacrifice the simplicity desirable for increasing access.

the most important development on the radar had been Bitcoin and related cryptocurrencies. But on the whole, central bankers' reaction to these was academic and casual: cryptocurrency was an interesting innovation, well worth studying for long-run implications, and one to keep an eye on for threats to stability, but unlikely to make any real difference in the role of central banks. The threat posed by Libra—a serious proposal by a well-funded and dynamic internet company—elicited an entirely different response, as central bankers sensed an immediate threat to their role, and the real possibility of central banks losing their connection to the payments system if there were flight from a domestic payments arrangement to a global alternative.

Lessons from Four Countries

Sweden

Sweden was one of the first major central banks seriously to investigate adopting a CBDC. It published its first report on the e-krona project in 2017 (Sveriges Riksbank 2017), although the work and discussion had begun at least two years before that. Sweden's early interest was stimulated by the fact that at that time, the country had gone further than any other down the road to becoming a cashless economy.

Academic and economic policy discussions a decade ago were full of enthusiasm for the abolition of physical cash, both because of its costs and because of its use for antisocial activities (Rogoff 2016). Authors enthused about those brave souls who managed to run their lives without recourse to cash at all (Wolman 2013) and to look approvingly at those economies where cash was disappearing fastest. In Sweden the decline in the use of cash was extreme; many stores did not take cash, and even many bank branches would not deal in cash (Skingley 2016, Alderman 2018). In this atmosphere, Sweden began its exploration of the legal and technological prerequisites for the introduction of an e-krona.

However, it also became generally apparent that there were down sides to the disappearance of physical cash as well, as the most vulnerable members of society might have the most difficulty transitioning to an electronic currency. The report out of the initial investigation emphasized the disadvantages of the disappearance of cash, and the fear that with its disappearance the public might have no central bank–provided means of payment.

No decision has been made on whether to issue the e-krona, and consultations with the government are ongoing. Meanwhile, the Riksbank has gone on to develop a proof of concept. Two sets of reports on this pilot project have been issued (Sveriges Riksbank 2021, 2022), examining the feasibility of particular possible designs without claiming which design would ultimately be adopted should CBDC be issued. The design considered would have the Riksbank issue electronic tokens to be distributed by wallet providers to the public through a distributed ledger, with responsibility for the verification and completion of transactions divided between

the Riksbank and the wallet providers. The e-krona system would run in parallel to existing payments arrangements, in order to increase robustness of the payment system overall.

The plans would allow for the separation of the storage of tokens (on the books of the participating institutions) from the keys permitting the transfer of the token (stored on the individual's wallet). In principle, this would allow for the possibility of offline payments arrangements, the feasibility of which is examined in the second of the technical reports.

Two things that are notable about the reports: unlike the Boston Fed/MIT report, they do not go into the question of scalability. Second, they do not exhibit a major concern with privacy: the designs examined are not anonymous, and the phase 1 project argues that anonymous CBDC “would have a very limited area of use” (p. 14).

Canada

Like the Riksbank, the Bank of Canada was an early entrant to the study of CBDC, with extensive examination of the variety of arguments for and against its adoption (Fung and Halaburda 2016, Engert and Fung 2017, Davoodalhosseini 2018, Kahn et al. 2018b). Unlike the Riksbank, the Bank of Canada focused its pilot work on wholesale CBDC. In project Jasper, the Bank of Canada investigated the use of a blockchain-based digital token in a variety of wholesale environments—as a settlement asset among commercial banks in the Canadian payments system (Chapman et al. 2017) and as a settlement asset in domestic financial clearing transactions (Jasper 2018).

The conclusions of these studies were consistent: establishing a permissioned blockchain for wholesale settlement was feasible, and indeed, relatively easy (the mock-ups were up and running in a surprisingly short time). But the arrangements gave no obvious advantages over the existing settlement arrangements, which are after all quite efficient. However, at each stage in the study the researchers hypothesized that additional benefits *might* be realized if the blockchain technology became widespread and greater interconnections were established with other payment and settlement systems. For example, Chapman et al. 2017 concluded: “A pure stand-alone DLT wholesale payment system is unlikely to match the net benefits of a centralized wholesale payment system. This is because some parts of a viable wholesale payment system are inherently centralized,” but “benefits may be obtained by integrating other assets on the same ledger as payments” or “if a DLT-based core interbank payment system can serve as the basis for other DLT systems to improve clearing and settlement across a range of financial assets.” It was argued that such benefits might be particularly great in an environment with cross-border transactions. A small proof-of-concept experiment was run linking DLT systems between Canada and Singapore (Jasper 2019).

On the retail side, the Bank of Canada has concluded, after examining the various arguments for CBDC, that there is no pressing case for adoption. The official statement (BOC

2020) describes its program of “capacity building,” in preparation for implementation should developments require it.¹² Two scenarios that could lead to implementation would be 1) a continued decline in the use of bank notes to the point where Canadians no longer had the option to use them in many circumstances, and 2) a “challenge to Canada’s monetary sovereignty” should an alternative digital currency “become widely used as an alternative to the Canadian dollar as a method of payment, store of value and unit of account.”¹³

The Bahamas

The Bahamas is our one example of a CBDC actually in use. The Sand Dollar was launched in 2020 and now has 20,000 active wallets (the Bahamas have a population of about 400,000) (Soderberg et al. p. 2). The Bahamas have several particular concerns that made it important to develop a CBDC. The first is geography. Remoteness of some communities out of reach of physical banking services not only leads to exclusion but also makes physical cash distribution expensive.¹⁴ Furthermore, it was important to have a solution that was robust to disruption: there was a need for “‘offline functionality’ even if communication between the islands is disconnected.” The intended solution “allows users to make a pre-set dollar value of payments when communications access to the Sand Dollar Network was disrupted” (CBOB 2019).

Sand Dollar wallets can be accessed with either a mobile phone application or using a physical payment card.¹⁵ Wallets for individuals come in two tiers: The basic Tier I allows only \$500 eWallet holding limit, with a \$1,500 monthly transaction limit. No government ID is required to enroll, and the Wallet cannot link to a bank account. The Tier II has a \$8,000 eWallet holding limit, with a \$10,000 monthly transaction limit, and requires a government ID and a link to a bank account. Merchant wallets must also link to a bank account and have business and tax identification. They can have holding limits up to \$1 million, with unlimited transactions.

The Central Bank of the Bahamas advertises the Sand Dollar as safer than cash: “if your mobile phone is lost or stolen your Sand Dollars are safe because they are not stored on the device” (<https://www.sanddollar.bs/individual>). However, part of the safety comes at the cost of having forgone offline functionality. Offline functionality was originally to have been

¹² As part of this capacity building, the Bank of Canada announced in March that it is involved in a 12-month collaboration with the MIT Media Lab’s Digital Currency Initiative exploring design issues. See <https://www.bankofcanada.ca/2022/03/central-bank-digital-currency-collaboration/>.

¹³ The statement emphasizes that such an alternative would likely be issued by private sector entities; however, the scenario would also presumably apply were the alternative another country’s CBDC.

¹⁴ Pressure on the country to improve its KYC (Know Your Customer) regulation also likely has increased the costs to individuals opening bank accounts.

¹⁵ Details are available at the Central Bank of the Bahamas website: <https://www.sanddollar.bs/>.

provided through local network redundancy, but “The telecommunication towers required in the solution are vulnerable to the same weather conditions as the main telecommunication system. Also, the geographical reach of the local networks is limited, which makes it difficult to make payments between islands.”¹⁶ Thus, some significant technical problems remain.

China

China already has an extensive online and mobile payment system dominated, not by banks, but by the major tech companies AntGroup (Alipay) and Tencent (WeChat Pay) on the order of a billion users each, with China’s population of approximately 1.4 billion. It does not yet have a CBDC, but the People’s Bank of China (PBOC) is currently running pilots of electronic CNY in more than 10 cities and regions, including a test conducted at the Beijing Winter Olympics in February. The pilot has involved payment processing and testing the basic technology as well as add-on features, such as facial recognition, tap-and-go, and programmability.¹⁷ Offline capability is linked to phone hardware. With the number of wallets approaching 10 percent of the population, the tests are extensive, although small relative to the private companies’ footprints. However, the average balances in wallets are small—RMB 3 (around \$0.47) for individual wallets and RMB 31 (\$4.90) for corporate wallets. The relatively high number of wallets suggests that many wallets were opened but are not being used for transactions or holding e-CNY balances.¹⁸ (To encourage participation, lotteries have provided free e-CNY that could be spent with merchants joining the pilot, with funding coming from local authorities.) According to officials, current throughput in the system is small—10,000 transactions per second—but the goal is to grow and offer a system that is as resilient as those provided by the dominant players.

The system provides individual and corporate wallets, which offer different transaction limits. Wallets can be hardware based, through an electronic card allowing touch-based transactions, or software based on the e-CNY mobile app used to manage transactions. Users can download the stand-alone app from software stores, or Alipay and Tencent apps can be used as the interface to manage e-CNY transactions.

In addition to the usual arguments given for the adoption of a CBDC (for example, improved payments services, particularly among populations in areas lacking internet connectivity), the Chinese authorities are likely to be concerned about the loss of government

¹⁶ Soderburg et al. (pp. 13–14). For another way to reconcile safety with offline functionality, see Kahn et al. (2021).

¹⁷ Duffie and Economy (2022) provide extensive analysis; Kumar (2022) interviews a PBOC official about the program.

¹⁸ For comparison, Ouyang reports that as of September 2020, the median size of a sampled user’s assets under management in an Alipay wallet was about 8 yuan, and the average size was about 5,521 yuan (Ouyang 2022).

control over the financial sector, where private companies dominate the payments landscape and collect vast amounts of data. The development of the e-CNY could be considered, at least in part, in alignment with other actions by the government and the central bank to rein in the powerful fintechs. Many observers argue that e-CNY could become an important tool for social control, with links to other government programs such as the social credit system (see, for instance, Duffie and Economy 2022, p. 37).

A distinctive aspect of the CBDC question in China is its international potential. China's importance in world trade has for many years exceeded the importance of its currency in global payments and finance. Several initiatives have begun to redress the imbalance (Nabar and Tovar 2017). While it is unlikely that development of the e-CNY by itself is a deciding factor, in concert with other programs the e-CNY could contribute to the increased importance of RMB globally. According to the PBOC, "though technically ready for cross-border use, e-CNY is still designed mainly for domestic retail payments at present" (PBOC p. 5). Nonetheless, one of the important potential developments for cross-border payments is the m-CDBC bridge, a BIS pilot project whose participants are the Digital Currency Institute of the PBOC, the Hong Kong Monetary Authority, the Bank of Thailand, and the Central Bank of the United Arab Emirates, and whose ultimate goal is to enable cross-border transactions between CBDCs (BIS 2021b). It is important to note the People's Bank of China explicitly states that such experiments "are preconditioned on mutual respect to monetary sovereignty and compliance," and that it supports the international standard that "CBDC supplied by one central bank should not disrupt other central bank's currency sovereignty and their ability to fulfill its mandate for monetary and financial stability" (PBOC pp. 5–6).

Conclusions

The messages for the United States from these experiences differ depending on whether we focus on retail or wholesale applications of CBDC and whether we consider domestic or international payments. I begin with the domestic retail case. The first thing to note is that some of the rationales for the adoption of CBDC in other countries simply do not apply to the US conditions. There is no groundswell of protest about current retail payment inefficiencies for which a CBDC would be the obvious response. The threat of invasion of the payment system by foreign alternatives is remote in the extreme. Although cash continues to become less and less important in the US payments landscape, the death of cash, often predicted, remains delayed (Cubides and O'Brien 2022). The possibilities of interest-bearing retail CBDC have largely become a side issue in other countries' discussions. Retail CBDC is unlikely to have a significant impact on the optimal policy rates for the Fed; in the United States, the main theoretical advantage would arise from the possibility of enforcing negative interest on cash—a political nonstarter, and in any event the zero lower bound continues to recede.

A basic retail CBDC could still serve useful purposes in the United States, as large institutions build private electronic applications with limited interconnectivity and as some

individuals continue to be undersupplied with banking and electronic payment access. Such a system could also serve as a competitive spur and a useful backstop. Nonetheless, it is hard to see the retail CBDC as being more than a niche operation, as private arrangements find ways to provide services that can cover ever-smaller transactions.

Moreover, as noted at the beginning of the article, it is not enough to say that CBDC could serve useful purposes; observers need to argue that CBDC is uniquely able to serve these purposes. If the goal is to improve the efficiency and competitiveness of existing retail payments services, a more direct solution might be to improve the links between private payment systems operators and central bank payment services, by opening the existing Fed payments backbone to a broader class of financial institutions. Establishing faster payments services and allowing properly regulated fintechs access to Fedwire accounts would solve much of the interoperability problems and reduce the barriers to entry in payment service provision. Therefore, unless a private retail arrangement unexpectedly threatens to dominate the US payment system, the two bigger questions in retail payments will remain: who gets Fedwire access, and how will faster payments services play out?

While there are good arguments for introducing domestic retail CBDC, domestic wholesale CBDC is a solution looking for a problem. It has been argued that in conjunction with the ability to write smart contracts, a CBDC could improve the operation of financial settlement systems and reduce liquidity costs. If the clearinghouses and other institutional structures remain in place, then it begs the question of why a government-provided CBDC is superior to an arrangement made within the institution. If what is envisaged is an arrangement where settlement is freed from clearinghouses, we are in the interesting but problematic realm where benefits of reduced liquidity requirements must be traded off against the potential legal complexities and dangers of automatic execution of programs (see, for example, Hinkes 2021). Such solutions will be a long way away.

In any event, the issues will have to do more with the nature of the settlement arrangement rather than the nature of the payment asset traveling through the system. If a solution is found, it is more likely to be based on stablecoins issued by regulated financial institutions than on a central bank asset.

The answer may be different in the case of international payments, both retail and wholesale. Perhaps one way to improve international services would be to standardize payments arrangements by linking CBDCs internationally, thereby eliminating a layer of complexity at the interface. While the Canadian experience is a cautionary tale, further explorations along the lines of the BIS experiment are warranted. Once again, however, the flurry of activity and interest may have more to do with the fear of irrelevance on the part of central bankers: once improved arrangements are put in place, then at least at the retail level it is not clear that the assets used need to be central bank money rather than regulated stablecoins or existing bank arrangements (for example, see Adams 2022). At the wholesale

level, there is the prima facie case that, as a payment asset, central bank money could be less prone to financial instability than private institutions' debt.

Finally, since the time that CBDC was first considered, there has been a major change in attitudes regarding payments privacy (Kahn 2018). Formerly, transactions privacy was simply regarded as an opportunity to evade taxes, launder money, or buy illegal goods. Now it is understood that privacy in general, and transaction privacy in particular, can provide safety and protection from harassment, including safety from the failures of others to protect counterparties' privacy. Balancing public needs for information and individual needs for privacy is complex, and the introduction of CBDC as a cash replacement will compound the complexity.

Note that the Bahamian solution allows for wallets with varying levels of privacy: anonymity for small private wallets, not for larger private wallets or merchant wallets. Other solutions propose privacy guarantees, without anonymity for transactions below certain amounts. Part of the issue is the question of who can best provide the "right" level of privacy protection, a public or a private provider.¹⁹ Some American consumers claim to be unworried about defending electronic privacy from commercial firms, while at the same time are wary of potential invasion of privacy by a central bank as an electronic currency provider. Desire for privacy is not always coherently expressed by individuals: there are well-known contradictions between people's stated attitudes and their behaviors (Barth and de Jong 2017).

These concerns will come to the fore when considering using CBDC for retail international payment. In the examples provided in this article, there has been a diversity of attitudes toward privacy in the countries examined, probably reflecting both government policy and national attitudes toward the proper balance between privacy and disclosure. If arrangements are made to provide retail payment through governmental portals, when different governments have different laws and attitudes toward privacy, the consequences can be serious for privacy advocates. This may, in fact, be one reason for the United States to continue its investigations into adoption of CBDC.

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¹⁹ Kahn (2018) argues that privacy protection should be regarded as an ecosystem, with different aspects of protection provided by different entities.

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