CBDC: Issues and Prospects

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Abstract: The rising popularity of online transactions, and the associated decline in the use of physical currency, is driving cash toward obsolescence. Thus, one could argue that a central bank *not* introducing a digital version of cash—a *central bank digital currency, or CBDC*—is making a *choice* to eschew direct involvement in the shaping of the modern payments system. The burgeoning academic literature on CBDC identifies many potential benefits, as well as risks, that vary depending on the design features of the CBDC and the environment into which the CBDC is introduced. Of these features, the level of remuneration paid on CBDC holdings, if any, is the most important. Carefully designed, a remunerated CBDC has the prospect of returning a net benefit to the society, with limited downside risk.

1. Introduction

Economies the world over are in the midst of rapid digitization, particularly in retail payments. Fewer people make payments with physical currency, and many choose not to carry significant cash balances. Debit and credit cards have long been supplanting cash in most developed economies, but even they

9. Board of Governors of the Federal Reserve System. The views expressed in this paper are those of the authors alone and should not be attributed to the Board of Governors or any of its staff. All errors are ours. None of the authors have any conflicts of interest to report. Corresponding author: Kyungmin Kim: kyungmin.kim@frb.gov.

are now being displaced by mobile payments. It seems clear that today's youth will grow up with little experience of ever using cash, or any physical token, in their daily routines. The coming obsolescence of cash furnishes an argument for introducing a public digital version of cash that does not rely on physical tokens such as paper bills and coins.

The academic literature identifies many economic benefits from the introduction of a CBDC, as well as some noteworthy risks.[10] To its proponents, CBDC has the potential to improve the allocative efficiency of the payments system by reducing the market power of banks and other payments system providers and by expanding access to digital payment services to people who are underserved. As a byproduct, CBDC could also transform economic rents that accrue to incumbent service providers into consumer surplus. In particular, a CBDC could generate social benefits by directly competing with bank deposit accounts. The increased competition would curb banks' market power, raise deposit rates and thereby could improve allocative efficiency and increase consumer surplus (Chiu *et al.*, 2023, for example). The resulting cost reductions could, in turn, broaden access to digital money—whether bank deposits, stablecoins, or CBDC—improving financial inclusion. Section 2 summarizes aspects of the design features of CBDC and how they affect adoption.

To its detractors, the disruption of the business model of the banking sector is a not a feature of CBDC but rather is a drawback. The competition between CBDC and bank deposits may improve allocative efficiency, but the concomitant *bank disintermediation* is perhaps the most salient risk associated with CBDC. Section 3 discusses this topic. The implied changes in banking could, in some circumstances, also be a source of diminished financial stability, but not always, as discussed in section 4. Others ask what market failure or inefficiency the introduction of CBDC is intended to address (see, for example, Waller, 2021). They argue in part that the forces of technical progress in finance—for example, blockchain technology, stablecoins, and DiFi—are already obliterating the economic rents that a CBDC would purport to capture for the public.

10. See Infante et al. (2024) for a review of the literature focused on the implications for the banking sector and financial stability.

Ultimately, the net effect of a CBDC is not determined solely by its introduction. CBDC is an asset that would be held by a variety of economic agents which could affect the distribution of central bank liabilities throughout the economy. This means that the central bank's balance sheet policy is an integral part of the general equilibrium effects, as argued in section 5. Section 6 considers some implications of the seemingly inevitable decline in the use of currency. Section 7 sums up and concludes.

2. CBDC take-up, remuneration, and other design features

The social and economic benefits of CBDC vary directly with take-up by businesses and households. The greater the take-up, the more the *network externality* associated with the joint, unquestioned use of a common currency accrues to society. The design of CBDC affects its attractiveness as store of value, which in turn determines its likely take-up and usage.

One possibility is minimal take-up, allowing the CBDC to quietly serve as a back-up digital payment mechanism, with scant repercussions for the current financial system. But take-up could be more substantial, depending on the design features of the CBDC, particularly its remuneration (Whited *et al.*, 2023). All else equal, adoption by individuals and businesses of a CBDC would rise with the rate of remuneration. As noted below, high take-up could have significant implications for the financial system, especially through its effects on the banking sector; however, other aspects of design could mitigate those implications.

Setting aside remuneration, a CBDC could have features that distinguish it from cash, depending on its design. For example, CBDC may not provide the same degree of anonymity as cash, and thus might face resistance from those who are concerned with potential breaches of privacy. On the other side of the ledger, less anonymity could be a beneficial feature insofar as public authorities are able to curtail the illegal activities such as money laundering that reliance on cash allows. Regardless, concerns regarding privacy would not be a deterrent for those who have already willingly adopted card- or mobile-based payment platforms that make no promise of anonymity and are often subject to government reporting requirements.

There may also be benefits from the flexibility to choose the remuneration rate on CBDC. It could strengthen the transmission of monetary policy by directly affecting the interest rate that households earn on money holdings, rather than relying on partial passthrough of money market rates to deposit rates. In addition, if the introduction of a remunerated CBDC were to lead to further diminished use of cash, it could expand the space for monetary policy by decreasing the effective lower bound on nominal interest rates, possibly to a substantially negative rate.

At the same time, it is noteworthy that central banks generally appear reluctant to embrace paying interest on CBDC, with experiments to date mostly paying zero interest and public communications about possibilities of introducing CBDC frequently ruling out the paying of interest. One reason for this reluctance to pay interest on CBDC may simply be inertia, a legacy of physical currency, which pays zero interest. Paying interest on CBDC would not be a fundamentally new kind of operation; many central banks already pay interest to financial institutions on their holdings of central bank reserves.[11]

3. CBDC and bank credit provision

A risk associated with CBDC that is commonly invoked is the potential for bank disintermediation. A CBDC, particularly if it were remunerated, would be a source of competition for funding for banks, which could increase banks' cost of funding, possibly resulting in a reduction in bank lending. If it paid interest, a CBDC could be an attractive store of value for a wide range of would-be depositors, meaning the displacement of deposits could be sizeable. Views differ on whether the implied disruption to bank business models would be welcome.

Banks would, naturally, be expected to react to the introduction of CBDC by changing the terms offered on deposits. Indeed, to the extent that the market for bank deposits is monopolistic, the post-CBDC equilibrium—

11. If there were large-scale conversion from currency to an interest-bearing CBDC, one (gross) cost would be a decline in seignorage revenues. However, provided that paper currency remains in circulation, the decline would be mitigated to the extent that holders of currency were motivated to do so by its anonymity. Thus, any loss of seignorage would have to be balanced against the anti-money-laundering/know-your-client benefits of the reduction in transactions in currency. Of course, this issue is not limited to CBDC.

especially if remunerated—would feature higher deposit rates, possibly along with *higher* deposit balances (Andolfatto, 2021). In this way, a CBDC could serve as the public option for digital payments that would establish a minimum standard in retail payments through its influence on industry competition. The increased competition would curb banks' market power, improving economic efficiency. At the same time, the potential disruption to deposits as a funding source for banks could restrict the provision of bank credit to businesses.

Suppose a CBDC were introduced that paid no interest. In that case, its take-up and usage would be determined by the convenience it provides relative to money-like alternatives. If the same transactions could be carried out using bank deposits, the demand for the unremunerated CBDC would be limited. Indeed, the literature suggests that, irrespective of the level of competition in the banking sector, an unremunerated CBDC need not have material effects on bank funding costs and therefore on lending (Andolfatto, 2021; Keister and Sanches, 2023; Chiu *et al*., 2023).

Now suppose the CBDC is remunerated at a rate that is relatively high; that is, close to the monetary policy rate. The value of the CBDC now extends beyond serving as a medium of exchange, as in the unremunerated case, into one as an attractive store of value. As such, it would pressure banks to offer higher rates on deposits. This, in turn, could induce banks to raise lending rates to restore net interest margins. In theory, whether this all leads to a reduction in both deposits and lending depends on the competitive structure of the banking industry and of adjacent players in financial markets. Depending on the structure of the deposit market, even if the CBDC interest rate were low relative to policy rates, it could still elicit competition in the market for deposits, resulting in an increase in deposit rates paid by banks. In this scenario, and assuming banks have significant market power in deposit markets, the CBDC rate would set a floor on deposit rates, with the increased competition inducing banks to offer more favorable contracting terms to depositors.[12] As noted above, the resulting increase in deposit rates could even result in an expansion of the deposit base (Andolfatto, 2021; Chiu *et al*., 2023).

12. See, Van Hoose (2017), Drechsler et al. (2017) and Carletti et al. (2024) for evidence on, and implications of, imperfect competition in banking.

Next, suppose that following the introduction of a CBDC, funds were to indeed flow out of the banking system. Even so, deposits are not the only source of funding for banks. Banks could react to a contraction in deposits by relying more on wholesale markets for funding, at least in part. In this regard, Whited *et al.* (2023) estimates that a CBDC with remuneration set equal to the policy rate would capture 32 percent of the U.S. deposit market, with less than a fourth of the impact on deposits passed through to lending. Increased reliance on wholesale funding for banks has its own implications, not all of which are appealing, but substantially reduced volumes of lending need not be one of them.

4. CBDC and financial stability

The introduction of a CBDC would likely have implications for the stability of the financial sector. It is useful to parse those implications into the effects at times when markets are functioning normally and the effects in times of financial market stress. In normal times, a CBDC could crowd out financial firms' use of private short-term debt as a source of funding, which would enhance financial stability, all else equal. In times of financial stress, however, CBDC could be an attractive place for funds to migrate to—that is, a source of *run risk*—which would undermine financial stability. The remuneration of the CBDC is an important factor in both cases.

During normal times, a CBDC that pays interest at rates close to prevailing money market rates could *discourage* financial firms from relying on short-term funding instruments, which are prone to runs. To see this, consider an environment with strong demand for safe assets that have money-like benefits. Financial firms could (and do) provide these benefits to investors by issuing private-label short-term funding instruments.[13] All else equal, this reduces the cost of short-term debt and encourages more issuance; the downside is an

13. Private repo is common in the United States, for example. Also, there was widespread issuance of private-label mortgage-backed securities (MBS) in the U.S. in the 00's. Those securities came to be viewed as toxic during the global financial crisis.

increase in financial firms' reliance on risky short-term private funding.[14] In this context, a CBDC with a remuneration rate close to short-term market rates could put an effective floor on financial firms' funding rates, reducing those firms' reliance on private short-term debt, potentially improving overall financial stability. That said, the net effect on financial stability depends on the riskiness of banks' alternative funding sources. If, for example, higher costs induce banks to substitute away from funding from retail deposits, which are regarded as "sticky," towards funding from wholesale deposits, which tend to be more sensitive to market conditions, the implications for financial stability become ambiguous.

During times of financial stress, a remunerated CBDC could be an attractive investment option that may encourage investors to "run to" if they came to doubt the stability of the financial sector. Here too, the strength of the mechanism rises with the competitiveness of the remuneration rate on CBDC. If the CBDC were unremunerated, its attractiveness would be limited—at least when prevailing market rates are materially greater than zero. But if the rate paid on CBDC were comparable to its alternatives, and if financial frictions were negligible, even small doubts of stability could manifest in large financial flows. The problem is exacerbated if CBDC were elastically supplied, as that would allow hit-and-run entry and exit of financial positions for a wide range of investors, jeopardizing the stability of the sector as a whole.[15] Given this description, it is probably not surprising that the academic literature on this topic has focused on alternative design features, such as caps on holdings or restrictions on convertibility, that amount to introducing financial frictions. These design features would either ameliorate the risk of a surge in CBDC take-up in times of financial stress or curb the extent of one. But these (gross) gains are not costless. They reduce the *ex-ante* attractiveness of CBDC as a store of value, which would presumably reduce uptake and thus limit the

14. The mechanism operates through the crowding out effect of government debt (see, for example, Greenwood et al., 2015). While the literature on crowding out typically focuses on how governments competing for funds with private borrowers induce increases in interest rates paid on debt, a remunerated CBDC would play a similar role.

15. Similar concerns were raised in the design of the Federal Reserve's overnight reverse repo facility (ON RRP), in which eligible non-bank counterparties can deposit funds via repos with the Federal Reserve. See Frost et al. (2015).

welfare gains to society that are associated with the widespread adoption of a common publicly supplied digital payments medium.

The presence, or absence, of a digital means of payment, other than bank deposits, has implications for banking regulation. The introduction of CBDC has the potential to reshape the banking system—for example, by reducing the banking sector's reliance on deposits—especially if CBDC were remunerated. Significant changes in the banking system, in turn, would likely affect the regulatory landscape and the balancing of trade-offs associated with ensuring the system's soundness. And because CBDC, like cash, would be a means of payment the viability of which would not depend on the soundness of the banking system, it could reduce the expected social cost of banking crises (Williamson, 2021).

5. Recycling of CBDC

The foregoing noted the possibility of CBDC displacing deposits in the banking system. It also noted the prospects for wholesale sources of funds serving as alternatives to bank deposits; in short, that funds do not simply disappear if they are not held at banks. In a similar fashion, private funds held as CBDC on the central bank's balance sheets also do not disappear. The hypothetical risks associated with the issuance of a CBDC highlight the importance of the central bank's balance sheet management policy—and in particular, the *recycling* of CBDC—as a critical determinant of the aggregate effect. The central bank's decisions regarding asset holdings backed by CBDC on its balance sheet interact with individuals' and businesses' investment decisions, which can mitigate or eliminate potential adverse effects (Infante et al., 2024).

Two choices appear to be particularly relevant: Whether, and by how much, to expand the central bank's balance sheet in response to conversions from deposits to CBDC and the resulting drain of central bank reserves; and what types of assets to hold on the central bank balance sheet. With regard to the latter, in many jurisdictions, the choice has been traditionally confined to government securities, but holdings of privately issued bonds or direct lending to private borrowers is possible in some jurisdictions and have been employed

at times.[16] The manner in which a central bank recycles an inflow from CBDC has implications for the degree of bank disintermediation and the financial stability risks associated with a surge in CBDC usage in times of financial stress. For example, if a central bank opts to redistribute an increase of CBDC directly to banks (through lending), the consequences of the potential associated drain in deposits would be ameliorated, albeit with potentially significant distributional implications. Overall, such a choice would have to be consistent with the central bank's operating framework, which could influence how extensive a role the central bank plays in the financial system. In any event, the upshot is that the debate about introducing CBDC is not simply whether it should be done; rather, a complete assessment is contingent on the central bank's policy regarding recycling CBDC and managing its balance sheet.[17]

6. CBDC and the future

The declining use of cash and increasing importance of privately issued means of payment imply reduced direct involvement of central banks in the monetary economy. In theory, there is nothing special about paper money or fiat currency backed by government promises.[18] However, in the world of competing private monies, a significant presence of money that is backed by the central bank might be necessary to ensure price stability. Fernández-Villaverde and Sanches (2019) shows that a purely private monetary system does not provide the socially optimum quantity of money and can deliver price stability only if some limit on the total issuance of private currencies is imposed. More broadly, Gorton and Zhang (2022) argues that governments should be wary of ceding to private actors their power over the issuance of money on the grounds that only government can ensure the underlying value of the assets that back them.

16. For example, some central banks purchased privately issued assets or lent to the private sector directly in response either to the coronavirus pandemic, or the market functioning issues associated with it.
17. See Infante *et al.* (2022) for a discussion of various potential outcomes of the central bank's policy.
18. For example, Andolfatto *et. al.* (2016) studies how the use of a privately issued currency backed up by shares of a broad stock market index could replace publicly issued fiat currency.

Ideally, the money and payments system of the future, with or without CBDC, will be more *interoperable* than is currently the case.[19] But there are no assurances. Duffie (2020) discusses how electronic payments system providers may have incentives to fence off their services, sacrificing payments efficiency to raise customer switching costs and limit interoperability. The creation of payment services anchored by digital currencies issued by the central bank could mitigate these incentives. If these new digital payment services make and receive payments in a common, safe, and public digital currency, interoperability is more easily achieved.

In the international and historical context, Gorton (2021) emphasizes the importance of interoperability across different jurisdictions, drawing on the experience of the National Banking Era in the United States. Prior to the National Banking Act of 1863, interstate trade was expensive and inefficient because of the use of competing private bank notes as a means of payment. The Act introduced a uniform currency, which catalyzed developments in banking that increased efficiency and interoperability in the transfer of funds.

Continuing in the international context, developments may result in some countries coming to find they have a narrowing range of options. Suppose, for example, CBDCs are introduced by some countries, but not all. One consequence could be that it hinders the monetary policy autonomy of non-CBDC economies, depending on the design of the CBDC. The strengthened international spillovers created by the introduction of CBDC could also force non-CBDC economies to alter their monetary policy reactions to shocks (see, for example, Minesso *et al.*, 2022). Finally, if some of the larger economies issued CDBCs, then to the extent those CBDCs were interoperable, they could become the preferred means to settle international financial transactions. In that case, households and businesses in the non-CBDC countries could end up bearing the incremental cost of international transactions with any profits earned accruing to foreign stakeholders.

19. Interoperability is the ability of systems to interact with one another quickly, seamlessly, and at a low cost. It can be divided into *functional interoperability*, meaning the ability to share data, assets, contracts and applications; *vertical interoperability*, referring to end-to-end integration of, for example, point-of-sale devices with user wallets and payment rails; *horizontal interoperability*, meaning the interface between systems at the same level, such as a distributed ledger with a bank-based business network; *legal and regulatory interoperability*, often centering on difficulties in coordinating anti-money laundering and know your customer responsibilities; and *technical interoperability*.

In sum, the retail payments system is an essential part of an economy's financial infrastructure. As such, there may be an intrinsic value for the central bank in maintaining an important role in payments. The dwindling use of cash points to currency becoming less useful as an "outside option"—a means for payments that does not rely on services, such as bank accounts, that are provided by the private sector. In these circumstances, CBDC can be viewed as a digital version of cash: a publicly provided means of payment that is also a central bank liability, and whose management is ultimately the government's responsibility. It has the potential for generating efficiency gains, but with greater stability than private monies. As such, CBDC could assume the role of cash as the publicly provided outside option for making payments, especially retail payments.

7. Conclusion

Under the right conditions, CBDC has the prospect of generating many social benefits. It can improve the efficiency of the banking system and enhance financial stability. As with any substantive change, however, there are risks, especially those associated with bank disintermediation. But arguably, central banks have the tools to mitigate them. Among those tools are the design features of the CBDC itself. Remuneration is a CBDC's most important design feature. A high rate of remuneration would induce more take-up of CBDC, which could be socially beneficial, all else equal. But that benefit would come at the likely cost of a disruption in the market for bank deposits. Restrictions on CBDC holdings, on remuneration of those holdings, or on rapid large-scale switching of balances, could mitigate the impact on banks. Viable alternatives to bank funding from retail deposits, or to banks as the source of lending, could also reduce the aggregate effects.

Finally, to the extent that one agrees that payments systems are part of the essential infrastructure for an economy and policymakers feel uncomfortable leaving that infrastructure entirely in private hands as the use of currency declines, the provision of a CBDC starts to look attractive.

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