

Digital Currencies

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Memorandum

TO: Deputy Director, Federal Reserve Bank Operations and Payment Systems
FROM: Director, Federal Reserve Bank Operations and Payment Systems
DATE: February 2020
RE: Fed-Issued Digital Currency

Introduction

Technology firms have sparked the digital transformation of payments, introducing innovative technology that may lower the cost of transactions, but also expose consumers to new risks. In an effort to ensure sovereign currencies remain at the center of each nation's financial system, an increasing number of central banks are engaged in some type of work relating to central bank digital currency (CBDC).¹ Indeed, as Chairman Powell recently testified, Facebook's Libra Project "lit a fire" under the Federal Reserve's consideration of this topic.² Accordingly, in light of the rapid transformation of payments, particularly with respect to the emergence of stablecoins—cryptocurrencies designed to minimize the volatility relative to the value of another financial asset—the Board of Governors of the Federal Reserve System requested that a team of staff economists brief the Board on potential designs for a Federal Reserve digital fiat currency. The economist teams have suggested two possible designs—"Fedcoin" and "Fedcount." There is an internal debate among the staff economists about which design might be better for payment efficiencies and monetary policy implementation, with some also expressing the view that no action should be taken by the Federal Reserve System at all.

Both proposals are still in their early stages, as described further below. However, given the fact that some central banks around the world, most notably China, have begun experimentation, or are considering experimentation, with central bank digital currency, we have been asked to evaluate the three proposals:

¹ Codruta Boar, Henry Holden and Amber Wadsworth, *Impending Arrival – A Sequel To The Survey on Central Bank Digital Currency*, BANK FOR INTERNATIONAL SETTLEMENTS (Jan. 2020), at 3 (2020) Of the 66 central banks surveyed for the report, nearly 80% (up from 70%) are engaged in some work related to central bank digital currency, <https://www.bis.org/publ/bppdf/bispap107.pdf>.

² Daniel Roberts, *Fed Chair Jay Powell grilled on China's cryptocurrency plans, US response*, YAHOO FINANCE (Feb. 11, 2020), <https://finance.yahoo.com/news/fed-chair-jay-powell-grilled-on-chinas-cryptocurrency-plans-us-response-211840877.html>.

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Fedcoin, Fedcount, and deferral of action until a later date. To that end, I would like your help with analyzing the potential legal and policy issues that could arise from the three proposals. Your task is to consider any design recommendations to guide the Federal Reserve Board forward, carefully weighed against the merits and demerits of maintaining the status quo. Another work stream is tasked with analyzing whether the Federal Reserve System possesses legal authority for implementing CBDC in the absence of new legislation, so for now assume that such authority exists. You should, however, consider any policy issues related to the institutional independence of the Federal Reserve System and the views that the Congressional oversight committee might have about decisions made by the Board of Governors with respect to CBDC and the role of the Federal Reserve System in the political economy. As Federal Reserve Governor Lael Brainard recently stated, “Given the dollar’s important role, it is essential that we remain on the frontier of research and policy development regarding CBDC.”³

Background

Functions of Money

Sound money must fulfill three classical functions: a medium of exchange, a store of value, and a unit of account.

First, in order for an instrument to function as a **medium of exchange**, the instrument must be able to facilitate the sale of goods and services. The seller in a transaction must accept the instrument as a means of payment with the belief that the seller can, in turn, give the instrument to another as a means of the seller’s payment for other transactions.⁴

Second, the instrument must serve as a **store of value**, preserving purchasing power over time. An instrument that is susceptible to depreciation, or failure to maintain its value, would not be considered sound money.⁵

Third, functioning as a **unit of account** requires the instrument to act as a yardstick for measuring and comparing value across goods and services, thus informing the economic decisions of its users.⁶

The Role of the Central Bank in the U.S. System

The Federal Reserve System forms the central bank of the United States. The Federal Reserve System features “(1) a central governing Board, (2) a decentralized operating structure of 12 Federal Reserve Banks, and (3) a combination of public and private characteristics”⁷ (for more information about the Federal Reserve System, see **Appendix Item 3**). The Board of Governors of the Federal Reserve System is based in the nation’s capital and supervises the 12 Federal Reserve Banks. The 12 Federal Reserve Banks “service financial institutions in 12 Federal Reserve districts.”⁸ Federal Reserve notes, commonly called cash, are issued by the separate regional Federal Reserve Banks, but printed by the U.S. Treasury. The 12 Federal Reserve Banks also “act as banker’s banks, providing a wide variety of services such as storing

³ Lael Brainard, Member, Bd. of Governors of the Fed. Res. Sys., remarks at the Symposium on the Future of Payments, Stanford Graduate School of Business, The Digitalization of Payments and Currency: Some Issues for Consideration (Feb. 5, 2020), <https://www.federalreserve.gov/newsevents/speech/brainard20200205a.htm>.

⁴ Bk. for Int’l Settlements, *Annual Economic Report*, BANK FOR INT’L SETTLEMENTS (June 2018), at 92 <https://www.bis.org/publ/arpdf/ar2018e.pdf>.

⁵ *Id.* at 91.

⁶ *Id.*

⁷ About the Federal Reserve System, Structure of the Federal Reserve System, <https://www.federalreserve.gov/aboutthefed/structure-federal-reserve-system.htm>.

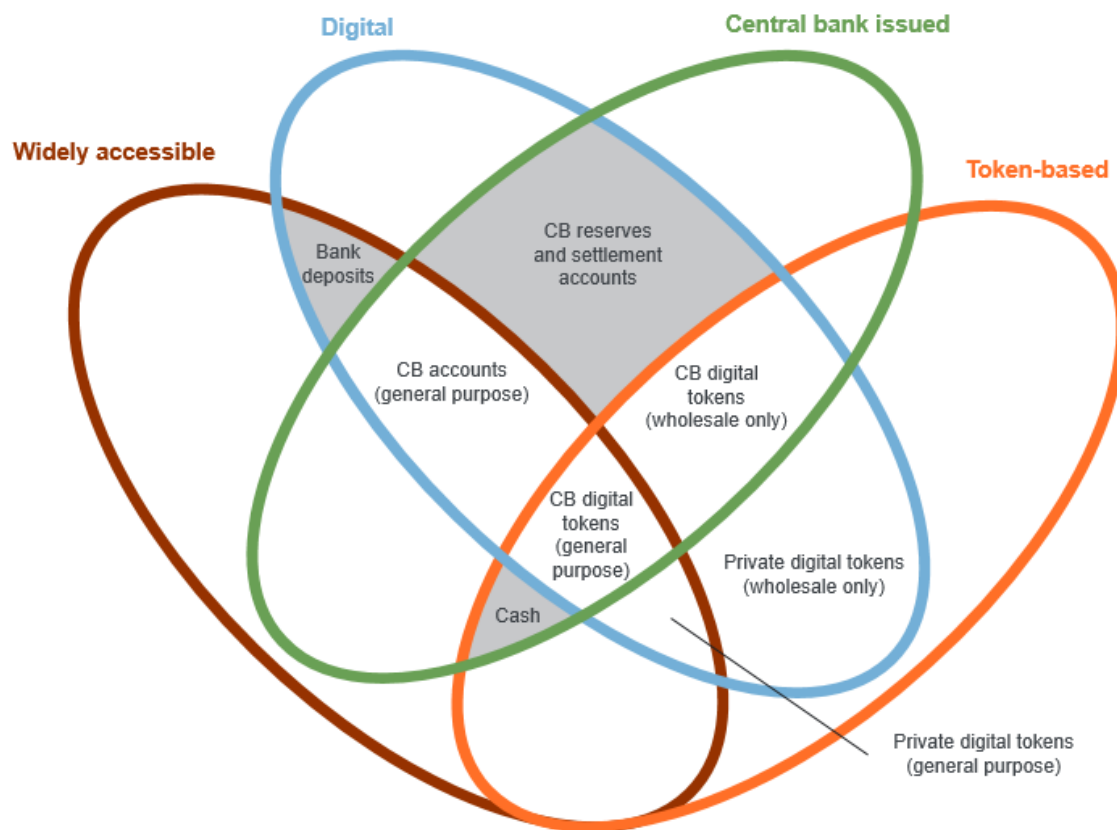
⁸ MICHAEL S. BARR, HOWELL E. JACKSON AND MARGARET E. TAHYAR, FINANCIAL REGULATION: LAW AND POLICY 939 (2d ed. 2018).

currency and processing checks and electronic payments for both banking institutions and the federal government.”⁹ Directly accessing these payment services “requires a **master account** at the nearest regional Federal Reserve Bank.”¹⁰ The Federal Reserve Banks only grant master accounts to banks.

The Federal Reserve System performs a number of critical roles for the U.S. economy. First, the Federal Reserve Board is charged by Congress to “pursu[e] the goals of ‘maximum employment, stable prices, and moderate long-term interest rates.’”¹¹ Second, “[t]he Federal Reserve is the primary organ responsible for carrying out U.S. monetary policy and, for many, that is its most crucial role.”¹² Third, the Federal Reserve’s circulation of cash, issued and delivered by the regional Federal Reserve Banks, to meet domestic and foreign demand also generates significant revenues for the U.S. government thanks to the U.S. dollar’s status as the global reserve currency.

Conventional Forms of Money in the U.S. Financial System

In the current U.S. financial system, money conventionally manifests in three forms: cash, commercial bank deposits, and central bank accounts, that is accounts held by banks at each of the Federal Reserve Banks through what is called a master account. As described below, the relationship between these three kinds of money is overseen by the Federal Reserve System.



⁹ *Id.*

¹⁰ *Id.* at 183.

¹¹ *Id.* at 49.

¹² *Id.* at 939.

Source: Adapted from Bank for International Settlements¹³

Cash consists of both metal coins minted by and paper notes printed by the government. Cash represents a liability of the central bank¹⁴ and is “legal tender for all debts, public charges, taxes, and dues.”¹⁵ The Federal Reserve Banks issue and supply cash to commercial banks in their districts, which is then circulated by commercial banks to users based on demand. Generally, anyone can access, store, and use cash. Due to its widely recognized authenticating features (for example, watermarks and holograms on higher value bills), payments involving cash typically do not require a trusted third party to record the transfer or verify the authenticity of the physical notes or coins.¹⁶ Consequently, settling transactions with cash is usually immediate and generally does not come with transaction fees.¹⁷

Cash also comes with costs attached for both the user, who bears the burden of storage and loss, and the government, which bears the burden of supporting the printing, minting, and initial delivery infrastructure. Although cash is convenient for settling smaller transactions immediately, it is inconvenient for large transactions. Holding and transferring large quantities of cash is both burdensome and unsafe. For these reasons, the proportion of cash in payment values has been declining in many major economies, including in the United States.¹⁸

From the government’s perspective, cash requires an expensive infrastructure to support its circulation and upkeep.¹⁹ In addition to the logistics of producing, storing, and transporting physical cash to accommodate new demand, the government has to periodically retire and replace unfit coins and notes to maintain existing supply, further consuming resources.²⁰ Even with these expenses, however, the government’s creation of cash generates significant profits for the United States government, due in part to the U.S. dollar’s role as a reserve currency, the widespread use of \$100 bills as a safe haven asset, or as the currency most valued in illicit transactions.

Money in **bank deposit accounts** consists of “electronically recorded deposit account liabilities on the ledgers of commercial banks.”²¹ This form of money is universally available to anyone with a bank account.²² Money stored in deposit accounts serves as “the main means of payment between ultimate users”²³ and “the main form of money holding of households and businesses.”²⁴ Its supply increases when commercial banks issue loans to borrowers or receive cash deposits and decreases when account holders “make debt repayments or interest payments to the bank.”²⁵ Money in bank deposit accounts, which is a

¹³ Comm. on Paymts. & Mkt. Infrastructures, Markets Comm., *Central bank digital currencies*, BANK FOR INT’L SETTLEMENTS (2018), at 5, <https://www.bis.org/cpmi/publ/d174.pdf>.

¹⁴ Walter Engert and Ben S.C. Fung, *Central Bank Digital Currency: Motivations and Implications*, BANK OF CAN. (2017), at 1, <https://www.bankofcanada.ca/wp-content/uploads/2017/11/sdp2017-16.pdf>.

¹⁵ 31 U.S.C. § 5103.

¹⁶ *Id.* at 1.

¹⁷ BARR, *supra* note 8, at 808.

¹⁸ *Id.*

¹⁹ Aleksander Berentsen and Fabian Schär, *The Case for Central Bank Electronic Money and the Non-case for Central Bank Cryptocurrencies*, 100 FED. RES. BK. OF ST. LOUIS REV. 97, 101 (2018), <https://doi.org/10.20955/r.2018.97-106>; <https://research.stlouisfed.org/publications/review/2018/02/13/the-case-for-central-bank-electronic-money-and-the-non-case-for-central-bank-cryptocurrencies>.

²⁰ For reference, there is an average life expectancy of 5.9 years for \$1 bills, 4.2 years for \$10, 3.7 years for \$50, and 15 years for \$100. *How Currency Gets into Circulation*, FED. RES. BK. OF N.Y. (July 2013), <https://www.newyorkfed.org/aboutthefed/fedpoint/fed01.html>.

²¹ Ole Bjerg, *Designing New Money—The Policy Trilemma of Central Bank Digital Currency*, Working Paper, COPENHAGEN BUS. SCH. (June 14, 2017), at 15, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2985381.

²² *Id.* at 14–15. As a practical matter, however, “[m]ore than 9 million U.S. households, including 15.6 million adults and 16.3 million children are unbanked, or lack an account at an insured depository institution.” BARR, *supra* note 8, at 826. There are “[a]nother 24.5 million households, comprising 51.1 million adults and 16.3 million children [who] are underbanked, meaning that although they have bank accounts, they also obtain financial services from non-bank, alternative-financial-services providers such as check cashers or payday lenders. Being unbanked or underbanked presents significant challenges for participating in many payment systems.” *Id.*

²³ Bk. for Int’l Settlements, *supra* note 4, at 93.

²⁴ Bjerg, *supra* note 21, at 12.

²⁵ *Id.* at 15.

private form of money (i.e., money that is a claim against private banks, rather than the central bank), is the predominant form of money in the U.S. financial system.

Money in **central bank accounts** is recorded digitally as liabilities on each Federal Reserve Bank's ledger.²⁶ As discussed earlier, direct access to central bank money is currently restricted to chartered banks and other depository institutions. Nonbank companies and individuals cannot directly access the accounts at a Federal Reserve Bank for payments or storage.²⁷ Supply of central bank money grows when commercial banks purchase government bonds or deposit funds with their Federal Reserve Banks and contracts when commercial banks borrow on a collateralized basis from their Federal Reserve Banks.²⁸ Instead of facilitating retail payments, the amounts deposited by commercial banks with the Federal Reserve Banks enable the settlement of wholesale interbank payments.²⁹

Taken together, these three conventional forms of money share overlapping features while retaining key distinctions. For instance:

- Cash and commercial bank deposits are, in principle, accessible to anyone, unlike master accounts,³⁰ which can only be opened by banks.
- Cash and master accounts are liabilities issued by the Federal Reserve Banks, unlike commercial bank deposits.³¹
- Commercial bank deposits and master accounts exist in digital form, unlike cash.³²

Beyond these abstract comparisons, the three forms of money share an operational infrastructure through the Federal Reserve System's partnership with the banking sector in circulating cash to the public.³³ Specifically, individuals can receive cash by converting digital money stored in their bank deposits into paper notes, most typically by a withdrawal from an ATM machine. These paper notes are purchased by the bank from its regional Federal Reserve Bank through a deduction from the amount held in the bank's master account and a corresponding delivery of physical notes.³⁴

²⁶ See *id.* at 14.

²⁷ If the Fintech Charters were granted master accounts, then access would be extended beyond depository institutions. See Howell E. Jackson, Margaret Tahyar and Carol Rodriguez, *Fintech Charter Case Study*, HARVARD L. SCH. (Feb. 2020), at 6–7.

²⁸ See Bjerg, *supra* note 21, at 15.

²⁹ Bk. for Int'l Settlements, *supra* note 4, at 93.

³⁰ Bjerg, *supra* note 21, at 15–16.

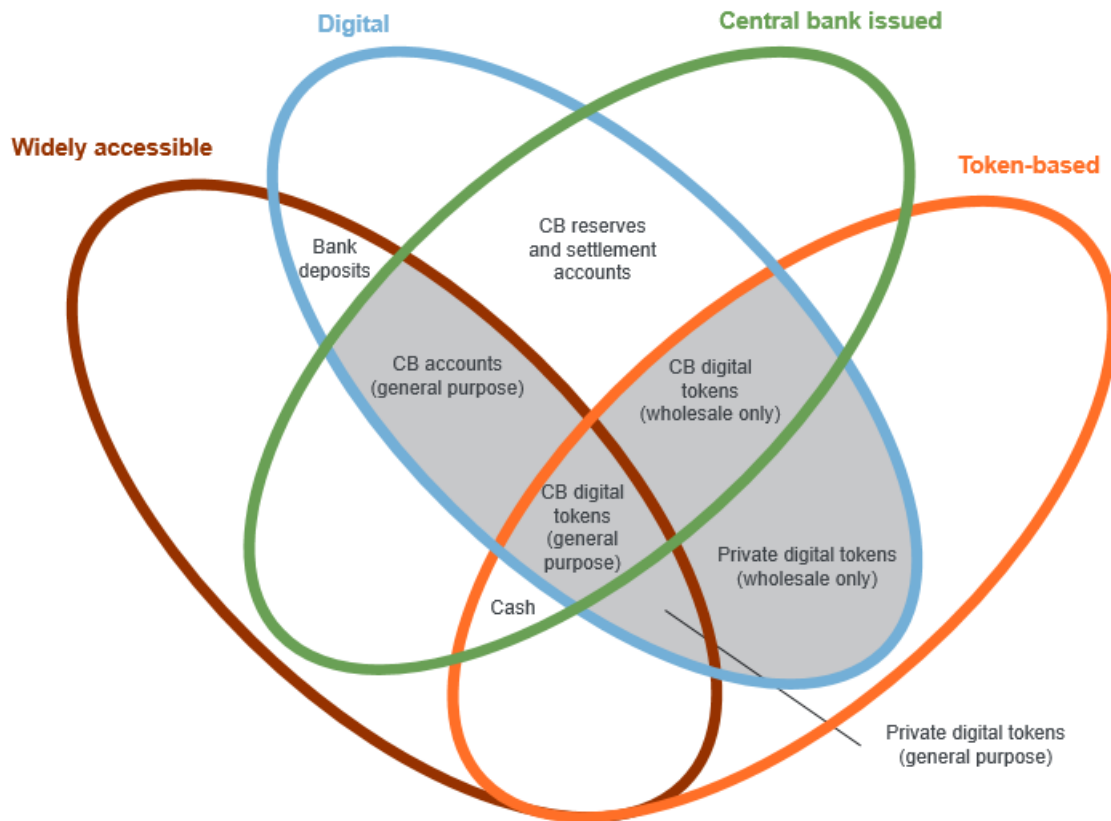
³¹ *Id.*

³² *Id.*

³³ Bk. for Int'l Settlements, *supra* note 4, at 93 (“[I]n almost all modern-day economies, money is provided through a joint public-private venture between the central bank and private banks, with the central bank at the system’s core.” This institutional arrangement is not confined to the Federal Reserve System).

³⁴ J.P. Koning, *Fedcoin: A Central Bank-issued Cryptocurrency*, R3 RESEARCH, (2016), 1t 25, https://www.r3.com/wp-content/uploads/2018/04/Fedcoin_Central_Bank_R3.pdf.

New Forms of Money?



Source: Adapted from Bank for International Settlements³⁵

Cryptocurrency

Cryptocurrencies, such as Bitcoin, Ethereum, and Ripple, are a type of digital currency that rely on cryptography to verify and secure transactions, as well as to manage the creation of new units.³⁶ In contrast to conventional forms of money, and in contrast to other digital currencies (for example, in-game currencies used by certain video game franchises), cryptocurrencies generally are not backed by a trusted institution and typically are not liabilities of any person or institution.³⁷

Distributed ledger technology, of which blockchain technology forms a subset, represents the technological engine underpinning many cryptocurrencies, including Bitcoin. Distributed ledger technology “refers to the protocols and supporting infrastructure that allow computers in different locations to propose and validate transactions and update records in a synchronized way across a network.”³⁸ As the term *ledger* implies, distributed ledger technology provides a means of recording account balances or transaction history. In most other contexts, electronic transactions are recorded on

³⁵ Comm. on Paymts. & Mkt. Infrastructures, *supra* note 13, at 5.

³⁶ BARR, *supra* note 8, at 835. For information on Bitcoin in particular, see Reuben Grinberg, *Bitcoin: An Innovative Alternative Digital Currency*, 4 HASTINGS SCI. & TECH. L.J. 159, 160 (2011).

³⁷ Lael Brainard, Member, Bd. of Governors of the Fed. Res. Sys., *Cryptocurrencies, Digital Currencies, and Distributed Ledger Technologies: What Are We Learning?* Speech at the Decoding Digital Currency Conference sponsored by the Federal Reserve Bank of San Francisco (May 15, 2018), <https://www.federalreserve.gov/newsevents/speech/brainard20180515a.htm>.

³⁸ Morten Linnemann Bech and Rodney Garratt, *Central Bank Cryptocurrencies*, BK. FOR INT’L SETTLEMENTS Q. REV. (Sept. 2017), at 55, 58, https://www.bis.org/publ/qtrpdf/r_qt1709f.pdf.

a *centralized* ledger. Generally, a trusted intermediary (e.g., the central bank, commercial banks, or PayPal) manages the central ledger to “track account holders’ balances and, ultimately, vouch for a transaction’s authenticity.”³⁹ However, this is not so with distributed ledger technology. As the name implies, the ledger is *distributed* across computers and other internet-connected devices in separate locations globally, all without the need for a trusted central authority.⁴⁰

For Bitcoin and many other cryptocurrencies, “[t]his ledger is the blockchain.”⁴¹ Transactions are recorded in batches, or “blocks,” with new blocks being “chained” in order to amend the existing ledger with additional transactions.⁴² This process of clearing and settlement happens around the clock—24/7/365—and it all occurs automatically, with minimal human intervention. Parties wishing to transact with blockchain technology must announce their transaction “to the entire network, effectively asking network participants to determine its authenticity.”⁴³ Responsibility for verifying the validity of new blocks is shared by nodes—or computers connected to the network—through a consensus mechanism, whereby the nodes agree to the common state of ledger usually with cryptographic tools and protocol rules.⁴⁴ For Bitcoin’s proof-of-work consensus mechanism, network participants compete to solve cryptographic puzzles necessary for validating a new block. As an economic incentive, the first to succeed receives newly issued units of bitcoin.⁴⁵

A critical distinction to keep in mind is that Bitcoin is an example of a *permissionless* system, where each node possesses a complete and current copy of the ledger. In principle, anyone can participate in validating transactions in a permissionless system. In contrast, a *permissioned* system only allows trusted nodes—in other words, participants approved by a central entity—to participate in updating the ledger. A permissioned system may involve additional access controls, such as verification of identity.⁴⁶

Many harbor doubts as to whether permissionless cryptocurrencies can function as sound money, much less supplant the use of cash. For instance, Professor David Yermack argued in 2013 that Bitcoin, which remains the most popular cryptocurrency, failed to satisfy the classical criteria of money. Although Bitcoin enjoys some acceptance as a form of payment, “the worldwide commercial use of bitcoin remains miniscule . . .”⁴⁷ He maintained that Bitcoin performs poorly as a unit of account since Bitcoin-based quotes for prices of ordinary goods commonly extend to “four or five decimal places with leading zeros, a practice rarely seen in consumer marketing and likely to confuse both sellers and buyers in the marketplace.”⁴⁸ Even then, his most severe reservation resided with Bitcoin’s prospects as a store of value given, among other factors, its high volatility.⁴⁹

³⁹ Trevor I. Kiviat, *Beyond Bitcoin: Issues in Regulating Blockchain Transactions*, 65 DUKE L.J. 569, 578 (2015); Bk. For Int’l Settlements, *supra* note 4, at 96.

⁴⁰ As such, this system is a “trustless” system.

⁴¹ *Id.*; see also Satoshi Nakamoto, *Bitcoin: A Peer-To-Peer Electronic Cash System*, BITCOIN (2009) at 3, <https://bitcoin.org/bitcoin.pdf>.

⁴² Comm. on Paymts. and Mkt. Infra., *Distributed Ledger Technology in Payment, Clearing and Settlement*, BK. FOR INT’L SETTLEMENTS (2017), at 3, <https://www.bis.org/cpmi/publ/d157.pdf>.

⁴³ Kiviat, *Beyond Bitcoin*, *supra* note 39, at 578.

⁴⁴ Comm. on Paymts. and Mkt. Infra., *supra* note 42, at 3–4.

⁴⁵ *Id.* at 4. Bitcoin is programmed to have a finite total outstanding supply. When Bitcoin creation ceases, “the incentive to validate transactions will likely be transaction fees.” Kiviat, *Beyond Bitcoin*, *supra* note 39, at 579–580.

⁴⁶ Bk. For Int’l Settlements, *supra* note 4, at 96.

⁴⁷ David Yermack, *Is Bitcoin a Real Currency? An Economic Appraisal*, Working Paper No. 19747, NAT’L BUR. OF ECON. RES., (rev. Apr. 2014) at 2, <https://www.nber.org/papers/w19747>.

⁴⁸ *Id.* at 2–3. There have been proposals to introduce a millibitcoin (mBTC), then worth \$1.85, to better account for pricing of conventional goods, Kai Sedgwick, *It’s Time to Change the Way We Measure Bitcoin*, BITCOIN.COM (Dec. 8, 2017), <https://news.bitcoin.com/its-time-to-change-the-way-we-measure-bitcoin/>.

⁴⁹ As discussed in footnote 42, Bitcoin’s supply is ultimately fixed. Although in theory the consensus mechanism could vote to lift this limit, doing so would be difficult in practice. This effective limit on supply presents a further challenge to Bitcoin’s viability as a form of money.

Since 2013, use of Bitcoin and other cryptocurrencies as a medium of exchange has increased, especially for those either without access to or wishing to bypass central banks and commercial banks. Yet, adoption remains far from widespread.⁵⁰

Stablecoins

Persisting volatility continues to bely cryptocurrency's function as a stable means for storing value. To many observers, cryptocurrency's extreme fluctuations and growing number of entrants harken ominously back to the era of wildcat banking, when state banks circulated their own currency that too often had dubious worth (see **Appendix Item 11**).⁵¹ Recently, stablecoins have emerged as an increasingly popular alternative to traditional cryptocurrencies. Stablecoins are digital assets that share the same technical features and infrastructure as traditional cryptocurrencies. However, a critical distinction between stablecoins and traditional cryptocurrencies is that a stablecoin's price is not determined by an open market. Instead, a stablecoin's price is stabilized by linking its value to a reference asset, or pool of assets, such as fiat currency, an exchange traded fund, or other cryptocurrencies. Given the potential increase in value stability, stablecoins may be more usable as a reliable means of storing value than traditional cryptocurrencies.

There are three common methods of stabilizing a stablecoin's value relative to another asset. First, under the depository receipt model, the stablecoin is a direct claim on a single currency.⁵² The stablecoin issuer must guarantee the value of the stablecoin by collateralizing all claims and committing to redeem the stablecoins at par value in the currency in which the claims were issued. The Monetary Authority of Singapore successfully implemented a blockchain-based inter-bank payment system using a version of the depository receipt model.⁵³

A second, alternative method of reducing stablecoin volatility is to peg a stablecoin's value to a "basket" of assets, commonly referred to as a currency basket. The currency basket can reference a pool of fiat currencies, highly-liquid government securities, cryptocurrencies, or some combination thereof. Notably, the assets in the currency basket are notional, and thus only provide a reference to determine a stablecoin's value. In other words, the holder of a stablecoin backed by a currency basket has no claim on the notional assets within the currency basket. Facebook announced in 2019 that it was participating in the launch of a stablecoin through the Libra Association. The Libra Association's second white paper, released in 2020, proposes a series of single-currency stablecoins as well as a multi-currency stablecoin, the Libra Coin, each of which will be fully backed by deposits and short-term government securities held by a network of custodians.⁵⁴

Third and finally, and relevant to the questions at hand, central banks can issue stablecoins in addition to bank notes and overnight deposits. Stablecoins, in this case, would be a central bank liability, similar to traditional cash, and held on the balance sheets of central banks. The Eastern Caribbean Central Bank (ECCB) partnered with Bitt Inc. to initiate a blockchain-based CBDC pilot wherein the ECCB would issue a

⁵⁰ Christian Barontini and Henry Holden, *Proceeding with Caution – A Survey on Central Bank Digital Currency*, BANK FOR INT'L SETTLEMENTS (Jan. 2019), at 14, <https://www.bis.org/publ/bppdf/bispap101.pdf>.

⁵¹ Robert C. Hockett, *Money's Past Is Fintech's Future: Wildcat Crypto, the Digital Dollar, and Citizen Central Banking 2* Stanford J. of Blockchain L. & Pol. ____ (June 28, 2019) <https://stanford-jblp.pubpub.org/pub/wildcat-crypto-fintech-future>, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3299555.

⁵² Barontini, *supra* note 50.

⁵³ Hockett, *supra* note 51.

⁵⁴ Libra, *Libra White Paper*, LIBRA, <https://libra.org/en-US/white-paper/>.

securely minted, digital Eastern Caribbean (EC) dollar.⁵⁵ The EC *digital* dollar will stand 1:1 with the EC *fiat* currency dollar.⁵⁶

Despite the growing utility of stablecoins, the integration of stablecoins within cross-border payment systems has been relatively limited. Private companies such as Facebook are designing payment systems that utilize a stablecoin design.⁵⁷ Regulatory reactions to the initial proposal have led to changes.⁵⁸ Nevertheless, government regulators are increasingly aware of the advantages of stablecoins and are looking to leverage the design methods discussed above as they explore the feasibility of CBDC. The Group of Seven (G7) stated that “[t]hese stablecoins might be more readily usable as a means of payment and store of value, and they could potentially foster the development of global payment arrangements that are faster, cheaper and more inclusive than present arrangements.”⁵⁹

Central Bank Digital Currency

The advent of permissionless cryptocurrencies has catalyzed interest among academics and policymakers in CBDC. In a survey conducted by the Bank for International Settlements (see **Appendix Item 7**), 70% of the responding central bank participants reported current or imminent engagement with CBDC work.⁶⁰ A number of central banks are researching CBDC, including the Bank of England, which released a paper in 2020 that addresses the opportunities and challenges presented by CBDC and sets forth CBDC design principles in order to engage discussion about whether to introduce CBDC in the United Kingdom.⁶¹ In addition, a few central banks have announced plans to implement CBDC in the next decade, most notably China.⁶² In 2014, the People’s Bank of China (PBOC)—China’s central bank—mentioned the possibility of researching the issuance of a digital currency by the PBOC,⁶³ and has since confirmed its intent to issue a digital currency: the Digital Currency/Electronic Payments (DC/EP). Recently, the PBOC accelerated its efforts to establish the DC/EP, confirming that at least seven financial institutions would receive and transact in the currency when it launches.⁶⁴ The DC/EP currency would be compatible with China’s existing financial infrastructure and service systems, and China aims to provide DC/EP to the world as a cross-border payment system linked to the RMB.⁶⁵

Despite the growing body of literature, CBDC currently is “not a well-defined term”⁶⁶ and standardization has yet to be reached in the form of an agreed taxonomy or lexicon. Because discussions about CBDC have

⁵⁵ Eastern Caribbean Central Bank, *ECCB to Issue World’s First Blockchain-based Digital Currency*, E CARRIB. CEN. BK. (Mar. 9, 2019), <https://www.eccb-centralbank.org/news/view/eccb-to-issue-worlds-first-blockchain-based-digital-currency>

⁵⁶ *Id.*

⁵⁷ Libra, *Libra White Paper*, LIBRA, <https://libra.org/en-US/white-paper/>.

⁵⁸ See, e.g., Richard Partington, *France to block Facebook’s Libra cryptocurrency in Europe*, THE GUARDIAN (Sept. 12, 2019), <https://www.theguardian.com/technology/2019/sep/12/france-block-development-facebook-libra-cryptocurrency>.

⁵⁹ G7 Working Group on Stablecoins, *Investigating the impact of global stablecoins*, BK. FOR INT’L SETTLEMENTS (Oct. 2019), <https://www.bis.org/cpmi/publ/d187.pdf>.

⁶⁰ Barontini, *supra* note 50, at 7.

⁶¹ *Id.* at 12; Bank of England, *Central Bank Digital Currency: Opportunities, challenges, and design* (Mar. 2020), <https://www.bankofengland.co.uk/-/media/boe/files/paper/2020/central-bank-digital-currency-opportunities-challenges-and-design.pdf?la=en&hash=DFAD18646A77C00772AF1C5B18E63E71F68E4593>.

⁶² Barontini, *supra* note 50, at 7.

⁶³ Mu Changchun, Dep. Dir. of the Paymt and Settlement Dept. of the People’s Bk. of China, *Design and Architecture of Central Bank’s Digital Currency*, Keynote speech at the CF40 Yichun Forum (Aug. 10, 2019), <http://www.cf40.org.cn/uploads/newsletter/20190803.pdf>.

⁶⁴ Michael del Castillo, *Alibaba, Tencent, Five Others To Receive First Chinese Government Cryptocurrency*, FORBES (Aug. 27, 2019), <https://www.forbes.com/sites/michaeldelcastillo/2019/08/27/alibaba-tencent-five-others-to-recieve-first-chinese-government-cryptocurrency/#10624b5a1a51>.

⁶⁵ Mu, *supra* note 62.

⁶⁶ Comm. on Paymts. & Mkt. Infrastructures, *supra* note 13, at 3.

mostly been conceptual, it might be most helpful to define CBDC by way of contrast: CBDC is central bank-issued digital money that is distinct from the existing master accounts at Federal Reserve Banks.⁶⁷

	Conventional forms of money			New forms of money	
	Cash	Bank deposits	Master account balances	Privately issued cryptocurrency or stable coins	Central bank digital currency
Digital	×	✓	✓	✓	✓
Central bank-issued	✓	×	✓	×	✓
Universally accessible	✓	✓	×	✓	(✓)
✓ = existing or likely feature, (✓) = possible feature, × = not typical or possible feature					

Source: Adapted from Bank for International Settlements⁶⁸

CBDC is also distinct from privately issued cryptocurrencies: CBDC would be backed by the government in the same way that current forms of fiat currency are backed and may assuage concerns of volatility because supply could be set programmatically (or algorithmically).⁶⁹ Some commentators regard a hypothetical CBDC as superior to permissionless cryptocurrencies in two respects. First, CBDC based on stablecoin design principles would be a more reliable and stable store of value.⁷⁰ Second, CBDC would likely avoid the “significant waste of resources” required by the consensus mechanisms used by some cryptocurrencies.⁷¹ For these reasons, a few commentators advocate CBDC as a solution for counteracting the migration of users from conventional forms of money to cryptocurrencies.⁷²

In recent years, China has taken measures to discourage Bitcoin transactions, specifically banning bank and payment institutions from dealings in Bitcoin in 2013 and, more recently, illegalizing ICOs raising cryptocurrencies such as Bitcoin.⁷³ Given the tepid acceptance of cryptocurrencies in mainstream payment ecosystems, central banks may turn to CBDC as an alternative method of integrating digital currencies within the monetary system. In a survey released by the Bank for International Settlements, “central banks are undertaking extensive work on [CBDC]. Globally, emerging market economics are moving from conceptual research to intensive practical development, driven by stronger motivations than those of advanced economy central banks. Central banks representing a fifth of the world’s population say they are likely to issue the first CBDCs in the next few years.”⁷⁴ Our own central bank has expressed an interest in analyzing the benefits of CBDC, stating in October 2019 that “at the Federal Reserve, we will continue to analyze the potential benefits and costs of central bank digital currencies and look forward to

⁶⁷ *Id.* at 4.

⁶⁸ *Id.* at 6.

⁶⁹ Brainard, *supra* note 37.

⁷⁰ *Id.*

⁷¹ Dong He, Karl Habermeier, Ross Leckow, Vikram Haksar, Yasmin Akmeida, Mikari Kashima, Nadim Kyriakos-Saad, Hiroko Oura, Tahsin Saadi Sedik, Natalia Stetenko and Concepcion Verdugo-Yepes, *Virtual Currencies and Beyond: Initial Considerations*, INT’L MON. FUND ¶120 (Jan. 2016), <https://www.imf.org/external/pubs/ft/sdn/2016/sdn1603.pdf>, (“Mining Bitcoin is costly, requiring computer processing power and associated energy costs. In addition, such systems involve a negative externality that causes overinvestment in computer power.”).

⁷² Hockett, *supra* note 51. See also Itai Agur, *Central Bank Digital Currencies: An Overview of Pros and Cons*, in DO WE NEED CENTRAL BANK DIGITAL CURRENCY? 113, 115 (2018) (“[O]ne incentive that central banks may have to develop a retail CBDC is to limit demand for private cryptocurrencies.”).

⁷³ Library of Congress, *Regulation of Cryptocurrency in China*, (July 12, 2018), https://www.loc.gov/law/help/cryptocurrency/china.php#_ftn4.

⁷⁴ Codruta Boar, Henry Holden and Amber Wadsworth, *Impending Arrival – A Sequel To The Survey on Central Bank Digital Currency*, BK. FOR INT’L SETTLEMENTS (Jan. 2020, at 3 (2020)), <https://www.bis.org/publ/bppdf/bispap107.pdf>.

learning from other central banks.”⁷⁵ (see **Appendix Item 2**). That said, Treasury Secretary Mnuchin tempered expectations, stating in December 2019 that he and Federal Reserve Chairman Jerome Powell “see no need for the Fed to issue a digital currency.”⁷⁶

Design Choices for Central Bank Digital Currency

Whether to introduce a CBDC and its optimal design features depend on the objectives and motivations of the central bank.⁷⁷ Designing a CBDC would need to take into consideration the following features, among others.

Currencies can either be token-based or account-based. If token-based, careful thought should be given to the appropriate degree of anonymity. As with all currencies, CBDC would also require an infrastructure to support its distribution (centralized or decentralized). As a *digital* currency, CBDC must also have in place a validation scheme (centralized or decentralized) to prevent double spending or identity theft. Finally, digital currencies can be subject to caps and/or accrue interest.

	Conventional forms of money			New forms of money		
	Cash	Bank deposits	Master account balances	Privately issued cryptocurrency	Token-based CBDC	Account-based CBDC
Tokens or accounts	T	A	A	T	T	A
Anonymity	✓	×	×	✓	(✓)	×
Decentralized distribution	✓	✓	×	✓	(✓)	×
Decentralized validation	✓	✓	×	✓	(✓)	(✓)
Capped	×	×	×	×	(✓)	(✓)
Interest-bearing	×	✓	✓	(✓)	(✓)	(✓)
✓ = existing or likely feature, (✓) = possible feature, × = not typical or possible feature						

Source: Adapted from Bank for International Settlements⁷⁸

Technology: Tokens or Accounts

The technological vehicle for the CBDC could be token-based, involving the transfer of an object of value from one wallet into another, or account-based, involving the transfer of a claim recorded on one account

⁷⁵ Lael Brainard, Member, Bd. of Governors of the Fed. Reserve Sys., Digital Currencies, Stablecoins, and the Evolving Payments Landscape (Oct. 16, 2019), speech At The Future of Money in the Digital Age, sponsored by the Peterson Institute for International Economics and Princeton University’s Bendheim Center for Finance, Washington, D.C., <https://www.federalreserve.gov/newsevents/speech/brainard20191016a.htm>.

⁷⁶ Saleha Mohsin, *Mnuchin, Powell See No Need for Fed to Issue Digital FX*, BLOOMBERG (Dec. 5, 2019), <https://www.bloomberg.com/news/articles/2019-12-05/mnuchin-powell-see-no-need-for-fed-to-issue-digital-currency>.

⁷⁷ NOTE: While the Bank of Canada has undertaken research and experimentation with CBDCs for interbank settlement (wholesale CBDC), our interests concern retail payments. To that end, please focus on the features that may be conducive towards a retail or general-purpose CBDC, which may differ from those for a wholesale CBDC.

⁷⁸ Comm. on Paymts. & Mkt. Infrastructures, *supra* note 13, at 6.

to another.⁷⁹ Cash and Bitcoin are examples of token-based money, whereas bank accounts and master accounts are examples of account-based money. One distinction between tokens and accounts turns on the method for verifying an exchange: the focus of verification for token-based money is the object transferred—i.e., the token—and the focus of verification for account-based money is the identities of the account holders.⁸⁰

Transfers involving tokens depend on the payee’s ability to “verify the validity of the payment object,”⁸¹ whether in the form of a metal or digital coin. Token-based systems must control for counterfeiting and enable the payee to validate the authenticity of the received token.⁸² This implication holds true for both physical and digital coins, as the payer could use a fake token in a transaction. Digital currencies introduce the additional problem of double spending, where the payer uses a *real* digital token for more than one transaction. Thus, policymakers for token-based systems must grapple with designing validation channels (e.g., via a recognizable design as with paper notes or via a decentralized consensus mechanism as with Bitcoin) for limiting counterfeit tokens and duplicate tokens. In contrast, transfers involving accounts rely on verifying “the identity of the account holder.”⁸³ Account-based systems must control identity theft and the unauthorized transfer or withdrawal of money held within valid accounts.⁸⁴ Consequently, policymakers for account-based systems must seek ways to validate the identity of the transacting parties.⁸⁵

Anonymity

As seen with Bitcoin and metal coins of old, token-based systems rely on verifying the authenticity of the exchanged token, not the identities of the transacting parties. The payer “need reveal nothing to the payee beyond the information associated with the specific coin.”⁸⁶ As such, a token-based CBDC can “be designed to provide different degrees of anonymity”⁸⁷ for its users or traceability for its transactions.⁸⁸

That said, Bitcoin and Ethereum would be more accurately characterized as granting pseudo-anonymity. While “[t]he blockchain does not record real names or physical addresses,” the transactions of the ledger are public and would be traceable to the owner should “the owner of the wallet become known.”⁸⁹ A paper trail may be harder to follow than a digital one.⁹⁰ Cash transactions are usually anonymous to third parties (such as banks) and the government.⁹¹ Indeed, the anonymity of cash is an attractive quality for many as a medium for protecting the privacy of their transaction histories. The degree to which a digital token should be—or even could be—designed to be anonymous with respect to (i) the counterparty, (ii) third-party validators, and (iii) the government remains an arena of lively debate.

⁷⁹ Tommaso Mancini-Grieffoli, Maria Soledad Martinez Peria, Itai Agur, Anil Ari, John Kiff, Adina Popescu and Celine Rochon, *CASTING LIGHT ON CENTRAL BANK DIGITAL CURRENCY*, INT’L MON. FUND, (Nov. 2018), <https://www.imf.org/en/Publications/Staff-Discussion-Notes/Issues/2018/11/13/Casting-Light-on-Central-Bank-Digital-Currencies-46233>.

⁸⁰ Comm. on Paymts. & Mkt. Infrastructures, *supra* note 13, at 4.

⁸¹ *Id.*

⁸² *Id.*

⁸³ *Id.*

⁸⁴ *Id.*

⁸⁵ *Id.* (“Identification is needed to correctly link payers and payees and to ascertain their respective account histories.”)

⁸⁶ Charles M. Kahn, Francisco Rivadeneyra and Tsz-Nga Wong, *Should the Central Bank Issue E-Money?*, Working Paper 2019-3a, FED. RES. BANK OF ST. LOUIS (Oct. 2018) at 11, <https://research.stlouisfed.org/wp/more/2019-003>, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3318871.

⁸⁷ Comm. on Paymts. & Mkt. Infrastructures, *supra* note 13, at 4.

⁸⁸ Mancini-Grieffoli, *supra* note 78, at 4.

⁸⁹ Ankit Panda, *Cryptocurrencies and National Security*, COUNC. ON FOR. RELATIONS. (Feb. 28, 2018), <https://www.cfr.org/background/cryptocurrencies-and-national-security>.

⁹⁰ See Agur, *supra* note 71, at 115 (“An essential feature of physical cash is its anonymity.”).

⁹¹ This is less often the case with respect to the transacting counterparty, since the cash transactions typically take place in person.

In contrast, account-based systems generally require some knowledge of the transacting parties' identities, such as the unique account number of the other party.⁹² However, even if there was relative counterparty anonymity—for example, where the parties only knew the other's account numbers—third-party anonymity is likely absent. As discussed below, the banks operating the accounts would be “required to have information regarding the individuals' identities for a variety of legal reasons.”⁹³

Degree of Centralization for Distribution and Validation

The central bank could opt to (i) directly oversee and manage the CBDC or (ii) delegate roles to other actors, such as commercial banks.

For a token-based CBDC, the Federal Reserve Banks could directly handle the distribution of new digital tokens to consumers and/or directly operate the validation process of digital tokens as a central validating node. Alternatively, the Federal Reserve Banks could collaborate with private entities to accomplish these responsibilities. For distribution, the Federal Reserve Banks could partner with commercial banks to circulate the digital tokens to their consumers based on demand. This decentralized distribution scheme is already used for the circulation of cash. As for validation, the Federal Reserve Banks could rely on a network of nodes outside the Federal Reserve System, be it a permissionless network or a permissioned network, to prevent double spending and preserve the integrity of the ledger.

Although an account-based CBDC would be held by Federal Reserve Banks, the degree to which the Federal Reserve Banks directly administer those accounts would remain a deliberate choice. A more centralized scheme would involve the Federal Reserve Banks designing and operating the account's verification requirements and associated payment and customer services. Alternatively, the Federal Reserve Banks could delegate the day-to-day responsibilities of administering the digital accounts to private sector firms, such as commercial banks.⁹⁴

Quantitative Limits

The Federal Reserve Board and the Federal Reserve Banks could impose quantitative limits on transaction or storage sizes for CBDC “as a way of controlling potentially undesirable implications or to steer usage in a certain direction.”⁹⁵ For instance, a cap could be imposed on the amount of CBDC that can be stored in a wallet or account. Alternatively, there could be a cap in the amount of CBDC a user can transact in for a single transaction. Finally, softer limits could be imposed, where the user would be permitted to hold or transact in an amount of CBDC beyond the limit—but with reduced anonymity.

Interest-bearing

Unlike cash, digital tokens and accounts could be designed to pay interest (positive or negative).⁹⁶ Indeed, existing forms of account-based money, such as master accounts and commercial bank accounts, are

⁹² Kahn, *supra* note 85, at 11.

⁹³ *Id.*

⁹⁴ See Ben Dyson and Graham Hodgson, *Digital Cash: Why Central Banks Should Start Issuing Electronic Money*, Positive Money (2016), at 16–19, https://positivemoney.org/wp-content/uploads/2016/01/Digital_Cash_WebPrintReady_20160113.pdf.

⁹⁵ Comm. on Paymts. & Mkt. Infrastructures, *supra* note 13, at 4.

⁹⁶ A negative interest rate means that the user pays the central bank to store its CBDC.

already interest-bearing. Importing this characteristic to digital tokens is also technically feasible. Positive CBDC interest rates would encourage storing CBDC and converting holdings of other currencies into CBDC; negative CBDC interest rates would encourage spending and converting holdings of CBDC into other currencies.⁹⁷

Legal and Policy Considerations

The particular bundle of features that define a CBDC will pose important legal and policy implications for the central bank. Provided below are a few to consider.

A. Concerns Related to Anti-Money Laundering, Know Your Customer, and Counter-Terrorism Financing

The Federal Reserve Board would need to consider concerns and policies relating to laws on anti-money laundering (**AML**) and counter-terrorism financing (**CFT**). Banks are subject to various laws that restrict them from providing financial services that would assist with criminal activity. Such laws also require banks to maintain customer due diligence programs for bank accounts and monitor suspicious activity, including cash transaction amounts exceeding \$10,000.⁹⁸ AML and know-your-customer laws (**KYC**) also apply to the Federal Reserve Banks but current compliance is easy in practice, as only banks have direct access to master accounts with Federal Reserve Banks.

CBDC that grants broad anonymity to users and limits traceability of transactions could become a favored medium for illicit activities, thereby potentially raising legal and reputational concerns for the Federal Reserve System. Cryptocurrencies have been criticized by some as a preferred medium of payment for facilitating illegal activities.⁹⁹ A recent Europol report found that cryptocurrencies “remain the primary payment mechanism for the payment of criminal services . . .”¹⁰⁰ For example, the Islamic State of Iraq and al-Sham (ISIS), a militant terrorist organization, solicited donations in Zcash and Bitcoin in order to finance their propaganda efforts.¹⁰¹ Cryptocurrencies also figure prominently in so-called Darknet markets, which are online marketplaces for illicit commodities and services, especially drugs.¹⁰² A recent paper concluded that “illegal activity accounts for a substantial proportion of the users and trading activity of bitcoin.”¹⁰³ Such concerns caution against issuing opaque digital tokens, at least not without a key in the government’s hands to unlock encrypted transaction information.

⁹⁷ Comm. on Paymts. & Mkt. Infrastructures, *supra* note 13, at 6.

⁹⁸ 31 C.F.R. § 1010.311 (“Each financial institution . . . shall file a report of each deposit, withdrawal, exchange of currency or other payment or transfer, by, through, or to such financial institution which involves a transaction in currency of more than \$10,000. . .”).

⁹⁹ Large-denominated paper notes—which grant almost complete anonymity—are also widely used for transactions related to criminal activities, including transactions abroad, see Kenneth S. Rogoff, *Response to Jeffrey Rogers Hummel’s Review of ‘The Curse of Cash’*, 14 *ECON. J. WATCH* (May 2017), at 164, 168 (“[W]hile there are many reasonable uses of the \$100 bill abroad, it is indisputably popular with Russian oligarchs, Mexican drug lords, illegal arms dealers, Latin American rebels, corrupt officials, human traffickers, etc., and of course North Korean counterfeiters.”), <https://econjwatch.org/articles/response-to-jeffrey-rogers-hummel-s-review-of-the-curse-of-cash>.

¹⁰⁰ EUROPOL, *Internet Organised Crime Threat Assessment (IOCTA) 2018*, EUROPOL (2019), at 58 (2018),

<https://www.europol.europa.eu/activities-services/main-reports/internet-organised-crime-threat-assessment-iocta-2018>.

¹⁰¹ *Id.* at 53 (“Cryptocurrencies represent a source of opportunity for terrorist groups, allowing them to move funds across borders while avoiding the regular banking scrutiny . . . [By] the end of 2017 . . . [Islamic State] sympathisers triggered mass cryptocurrency (Bitcoin and the more anonymous Zcash) donation campaigns in [Islamic State] affiliated websites as well as in chat environments (e.g. Telegram) to support their cause.”).

¹⁰² *Id.* at 47. (In 2014, the FBI and DEA shut down Silk Road, perhaps the most infamous Darknet market).

¹⁰³ Sean Foley, Jonathan R. Karlsen and Tālis J. Putniņš, *Sex, Drugs, and Bitcoin: How Much Illegal Activity Is Financed Through Cryptocurrencies?*, OXFORD L.: OXFORD BUS. L. BLOG (Feb. 19, 2018), <https://www.law.ox.ac.uk/business-law-blog/blog/2018/02/sex-drugs-and-bitcoin-how-much-illegal-activity-financed-through> (“For example, approximately one-quarter of all users (25%) and close to one-half of bitcoin transactions (44%) are associated with illegal activity. The estimated 24 million bitcoin market participants that use bitcoin

On the other hand, there may be legitimate demands for anonymity to safeguard privacy. Transacting parties might seek to avoid the unwelcome nuisance of directed advertising or weightier dangers of identity theft or personal harm.¹⁰⁴ Purchase history could also reveal health-related conditions and shopping habits, which, while not unlawful, could cause embarrassment. After all, “knowledge by a third party of the payee, amount, and time of payment for every transaction made by an individual can reveal a great deal about the individual’s whereabouts, associations and lifestyle.”¹⁰⁵ The trends towards privacy around consumer data means that users are increasingly worried about what happens to their information after its collection, since data could be shared, sold, or lost. Indeed, the anonymity of cash remains an attractive quality for many as a medium for protecting the privacy of their transaction histories. Even if the government or company collecting the data fully aligned with the user’s interests, others—such as foreign states or rogue hackers—could also be trying to get ahold of that information.

B. Monetary Policy

Provocatively, CBDC could expand the Federal Reserve’s arsenal for controlling monetary policy in two respects. For the purposes of this briefing, please consider how CBDC’s implications for monetary policy relate to discussions on whether consumers’ usage of currency should fall outside or within the control of the central bank.¹⁰⁶ Negative interest rates are highly controversial and viewed by many as a confiscation of private property. Since a direct deduction would be made from the account, negative interest rates are quite different from the erosion of inflation. Negative interest rates, as used in Europe, and as recently suggested by President Trump, have been limited to the wholesale accounts of commercial banks with the central bank. They have not been imposed upon consumers. This analysis should include how the controversial nature of these policies may impact the political economy.

First, replacing cash with an interest-bearing digital currency could grant the Federal Reserve a powerful new instrument for effectuating negative interest rates¹⁰⁷—which means that the user pays the central bank to store its currency—a policy theorized to discourage users from hoarding money and stimulate spending in the economy. Because cash has no interest rate, a central bank’s ability to cut interest rates becomes constrained when it approaches negative interest rate territory as people can convert their holdings in the banking system into cash. However, if cash were to be supplanted by an interest-bearing CBDC, the Federal Reserve could be able to overcome this effective lower bound.¹⁰⁸

Second, account-based CBDCs would enable the Federal Reserve to proactively airdrop funds into the accounts of consumers as another way of encouraging spending.¹⁰⁹ Some argue that such “helicopter drops” would operate more directly and precisely than reliance on quantitative easing, interest rate

primarily for illegal purposes (as at April 2017) annually conduct around 36 million transactions, with a value of around \$72 billion, and collectively hold around \$8 billion worth of bitcoin. To give these numbers some context, the total market for illegal drugs in the US and Europe is estimated to be around \$100 billion and €24 billion annually.”)

¹⁰⁴ Bech and Garratt, *supra* note 38, at 64.

¹⁰⁵ David Chaum, *Blind Signatures for Untraceable Payments*, in *Advances in Cryptology: Proceedings of Crypto 82*, 199 (David Chaum, Ronald L. Rivest and Alan T. Sherman eds. 1983).

¹⁰⁶ NOTE: An economic policy division is handling the precise implications on monetary policy so no need for you to closely parse the economic technicalities or the merits of deploying the following policies for the purposes of our briefing.

¹⁰⁷ See Kenneth Rogoff, *Dealing with Monetary Paralysis at the Zero Bound*, 31 J. OF ECON. PERSPS. 47, 57-58, (Summer 2017), https://scholar.harvard.edu/files/rogoff/files/dealing_with_monetary_paralysis_at_the_zero_bound.pdf.

¹⁰⁸ See *id.*

¹⁰⁹ Some suggest that helicopter drops could also be performed by token-based CBDC, see, e.g., Mike Bird, *HSBC Says the Blockchain Could Be Used for “Helicopter Money,”* BUS. INSIDER (Nov. 9, 2015), <https://www.businessinsider.com/hsbc-says-the-blockchain-could-be-used-for-radical-central-bank-helicopter-money-policies-2015-11?r=UK&IR=T>, but this mechanism would likely be less straightforward; see Dyson and Hodgson, *supra* note 93, at 22 (“[I]t would be extremely easy for the Bank of England to make small and regular ‘helicopter drops’ to every citizen, as a tool of monetary policies.”).

adjustments or commercial bank lending.¹¹⁰ Furthermore, helicopter drops can be performed universally on all accounts or on a selective basis, depending on the relevant situation.¹¹¹ The operational difficulties of getting stimulus and unemployment checks to taxpayers during the COVID 19 pandemic has illustrated the need for a better system of distribution than mailing checks or cards.

These options would come at severe political cost, which you should account for in your briefing preparations. First, the imposition of negative interest rates assumes a feasible path towards eliminating cash. As a matter of practical reality, the abolition of cash and the threat of negative interest rates would confirm the suspicions held by broad demographic swaths of the country about the Federal Reserve's ambitions for repressing financial autonomy (see **Appendix Item 13** and **Appendix Item 18**). Second, helicopter drops overtly tread into controversial decisions about redistribution—for example, decisions about how much money should be delivered and to whom.¹¹² Both actions could provoke public backlash and reignite critiques of the democratic legitimacy and institutional independence of the Federal Reserve.¹¹³

C. Seigniorage

Seigniorage, the profit made by the central bank from its issuance of currency (a function of the currency's face value *minus* production and distribution costs),¹¹⁴ forms a vital source of revenue for the Federal Reserve System and the U.S. Treasury (that is, the American taxpayer).¹¹⁵ Because of its status as the leading international reserve currency, the U.S. dollar generates substantial seigniorage revenues compared to other national currencies.¹¹⁶ Seigniorage is particularly pronounced for high-denomination bills (namely \$100 bills), which account for nearly 80% of the total value of U.S. dollars in supply¹¹⁷ and which also enjoy high demand outside the United States.¹¹⁸ The Federal Reserve System does not rely on congressional appropriations,¹¹⁹ which could fluctuate based on political pressures. The independent funding of the Federal Reserve provides an additional safeguard for its institutional autonomy and independent policymaking.¹²⁰

¹¹⁰ Dyson, *supra* note 93, at 2, 8.

¹¹¹ For example, the government could selectively use helicopter drops for lower-income households to stimulate spending and “cushion[] their purchasing power from the effects of the downturn as well as from the temporarily negative level of the CBDC interest rate.” Michael D. Bordo and Andrew T. Levin, *Central Bank Digital Currency and the Future of Monetary Policy*, Econ. Working Paper 1714 3 n. 10, HOOVER INSTITUTION (Aug. 2017), https://www.hoover.org/sites/default/files/research/docs/17104-bordo-levin_updated.pdf; see also Dyson, *supra* note 93, at 8; Mancini-Griffoli, *supra* note 78, at 16 n. 22 (“[Helicopter drops] would not necessarily reach all citizens.”).

¹¹² Mancini-Griffoli, *supra* note 78, at 16 n.22 (“[T]he issue of legitimacy remains: how does the central bank decide how much to transfer to each household given the notable and very explicit redistributive consequences? Finally, helicopter drops would continue to be viewed as a form of monetary financing, thus undermining central bank independence.”).

¹¹³ See BARR, *supra* note 8, at 49 (“The Federal Reserve Board’s power, however, remains controversial, and many critics want the Federal Reserve Board weakened or abolished. Critics allege that the Federal Reserve Board is secretive and undemocratic. . . .”); see also PAUL TUCKER, *UNELECTED POWER: THE QUEST FOR LEGITIMACY IN CENTRAL BANKING AND THE REGULATORY STATE* (2018).

¹¹⁴ Engert, *supra* note 14, at 3.

¹¹⁵ See, Bd. Of Governors, *Who Owns the Federal Reserve?*, FAQs, FED. RES. SYS, https://www.federalreserve.gov/faqs/about_14986.htm (“[T]he Federal Reserve Banks are required by law to transfer net earnings to the U.S. Treasury, after providing for all necessary expenses of the Federal Reserve Banks, legally required dividend payments, and maintaining a limited balance in a surplus fund.”).

¹¹⁶ To illustrate, the Federal Reserve Banks transferred to the U.S. Treasury \$97.7 billion, \$91.5 billion, \$80.2 billion, and \$62.2 billion (estimated) in earnings remittances in 2015, 2016, 2017, and 2018, respectively, Bd of Governors, *Press Release: Federal Reserve Board announces Federal Reserve Bank income and expense data and transfers to the Treasury for 2018*, FED. RES. SYS. (Jan. 10, 2019), <https://www.federalreserve.gov/newsevents/pressreleases/other20190110a.htm>.

¹¹⁷ Kenneth S. Rogoff, *THE CURSE OF CASH: HOW LARGE-DENOMINATION BILLS AID CRIME AND TAX EVASION AND CONSTRAIN MONETARY POLICY*, 3, 51 (2016).

¹¹⁸ See Ruth Judson, *Big Note, Small Note: Central Bank Digital Currency and Cash*, in *DO WE NEED CENTRAL BANK DIGITAL CURRENCY?* 33, 35 (2018) (“[T]he estimates in Judson (2016) indicate that about 70% of \$100s could be held abroad, with the rest held at home.”); ROGOFF, *supra* note 116, at 39 (“[F]oreign holdings . . . might explain as much as 50% of US dollar holdings.”).

¹¹⁹ Bd. Of Governors, *What Does It Mean that the Federal Reserve Is “Independent Within the Government”?*, FAQs, FED. RES. SYS. (Mar. 1, 2017) https://www.federalreserve.gov/faqs/about_12799.htm (“The Federal Reserve does not receive funding through the congressional budgetary process.”); Bd. Of Governors, *Who Owns the Federal Reserve?*, FAQs, FED. RES. SYS., https://www.federalreserve.gov/faqs/about_14986.htm.

¹²⁰ Christopher J. Waller, *Independence + Accountability: Why the Fed Is a Well-Designed Central Bank*, FED. RES. BANK OF ST. LOUIS REV. 293, 298 (2011) (“[A] common method for politicians to entice government agencies is to threaten to cut the agencies’ budgets To counteract

Seigniorage revenues would decline if demand for U.S. currency decreases. Cash’s share in payment amounts has dropped considerably over recent years. Its decline could continue if users begin to favor cryptocurrencies or foreign currencies over U.S. currency, whether that be paper notes or digital notes. Although for now these concerns remain far from compelling, further developments in stablecoins—currently mostly experimental¹²¹—and non-U.S. CBDCs—currently mostly conceptual¹²²—could provide an appealing alternative to the U.S. dollar. On the other hand, some have argued that developing a U.S. CBDC could recover leakage of or even exceed the seigniorage from U.S. cash.¹²³ This, of course, hinges on the perhaps overoptimistic assumption that future demand for a U.S. CBDC would match or exceed the existing demand for U.S. cash. Indeed, replacing cash with a CBDC that fails to appeal to users could inadvertently hasten the decline of seigniorage.

D. Financial Stability

Some academics worry that a retail CBDC that resembles bank deposits could raise the costs of deposit-taking for commercial banks, thereby reducing their ability to perform productive lending. Because a CBDC would be backed by the U.S. government, it would pose a safer alternative to bank deposits, which would be guaranteed only up to the deposit insurance limit of \$250,000 per depositor.¹²⁴ There is a policy question whether it is sensible for the U.S. government to provide what would be, in effect, unlimited insurance of deposit funds. In times of crisis, the qualities of a CBDC having the “safety of physical cash but convenience of bank deposit accounts”¹²⁵ could induce depositors to flee from depository institutions towards the central bank, thereby weakening financial stability.¹²⁶ Indeed, the traditional bank run has been caused by depositors converting bank deposits into cash. A conversion of bank deposits into CBDC would have a similar impact on bank balance sheets and stability. Unlike a traditional bank run, the speed and scale would likely be unprecedented since a digital run could be triggered at the click of a button.¹²⁷

Others, however, are less worried about financial stability. Some, including Professor Morgan Ricks, embrace the perceived structural implications of expanding the central bank’s role and causing “large-scale migration from bank deposits” to the central bank (see **Appendix Item 14**).¹²⁸ These proponents take the view that radical disintermediation of the private banking sector from deposit-taking would generate *more* financial stability, not less.

E. Cybersecurity

this possibility, Congress gave the Federal Reserve budget autonomy when it created the Fed in 1913. The Fed was given the power to earn its own income and spend it without government interference.”)

¹²¹ Stablecoins seek to overcome the volatility endemic among cryptocurrencies. Specifically, they are a type of crypto-asset for which the value is pegged to the value of another asset, such as the U.S. dollar, gold, or algorithmic pricing based on circulation supply. Santiago Fernández de Lis, *Central Bank Digital Currencies: Features, Options, Pros and Cons*, in *DO WE NEED CENTRAL BANK DIGITAL CURRENCY?* 46, 54 (2018).

¹²² Barontini, *supra* note 50, at 1 (“The survey shows that, although a majority of central banks are researching CBDCs, this work is primarily conceptual and only a few intend to issue a CBDC in the short to medium term.”).

¹²³ See Dyson, *supra* note 93, at 11–12; see also Morgan Ricks, John Crawford and Lev Menand, *Digital Dollars*, (Vanderbilt Univ. Law Sch., Research Paper No. 18-33, also Univ. Cal. Hastings Research Paper No. 287) (rev. Feb. 10, 2020), at 16–17, <https://ssrn.com/abstract=3192162>.

¹²⁴ *But see* Mancini-Griffoli, *supra* note 78, at 25 (commenting that while deposit insurance does not immunize banks from runs, it significantly mitigates the risk).

¹²⁵ Dyson, *supra* note 93, at 27.

¹²⁶ Comm. on Paymts. & Mkt. Infrastructures, *supra* note 13, at 16.

¹²⁷ *Id.*

¹²⁸ Ricks, *supra* note 122. (While Professor Ricks and his coauthors would prefer “more traditional nomenclature,” *id.* at 25–26, his FedAccount proposal is an example of a universally accessible, accounts-based CBDC.)

While offering convenience and efficiencies, digitization also carries risks of cyberthreats, including malware and fraud.¹²⁹ Cybersecurity is a significant operational risk and central banks are not immune to hacks.¹³⁰ In fact, instituting a CBDC could elevate the profile of the central bank as a target for cyberattacks.¹³¹ The likelihood and severity of cyberattacks would be further exacerbated for a CBDC that enjoys reserve currency status and is universally accessible, which would open the platform to “many participants and points of attack.”¹³²

Options for a U.S. Central Bank Digital Currency

The two proposed CBDCs aim to improve the convenience and lessen the costs of payment systems, and enhance implementation of monetary policy. With this background in mind, please consider the three options discussed below. Both proposed CBDCs would be issued by Federal Reserve Banks, would be denominated in the U.S. dollar, and would also be convertible with other forms of money; similar to cash, both CBDCs would be deemed to be legal tender. As a third option, consider whether it would be more prudent to adopt a wait-and-see approach, and stick with the existing system.

Option 1: Fedcoin

Fedcoin is a digital token built on a permissioned blockchain (Fedchain)¹³³ and issued by the Federal Reserve Banks. Unlike permissionless cryptocurrency, like Bitcoin, the production of Fedcoin is managed and controlled by the Federal Reserve Banks, which also serve as the only trusted parties in the network. Federal Reserve Banks would possess the ability to create and destroy Fedcoin in order to preserve a 1:1 conversion ratio between Fedcoin and the dollar. Although Federal Reserve Banks would maintain Fedcoin’s value, approved nodes would maintain the ledger’s verification, validating new transactions and screening out counterfeiting and double spending. These nodes would be operated by a select group of large commercial banks approved by the Federal Reserve Banks.

Users cannot directly access Fedcoin through an account at a Federal Reserve Bank but must withdraw Fedcoin from their commercial bank accounts. Once withdrawn, the Fedcoin becomes anonymous to the bank. Subsequently, Fedcoin may be stored in digital wallets provided by various private sector firms (*e.g.*, banks or fintech companies) that are certified by a Federal Reserve Bank. Anyone who purchases and installs the requisite wallet software into a smartphone or personal computer is able to store and pay with Fedcoin. A user can set up as many addresses for the wallet as he or she wishes. Once the wallet is set up, a user can engage in transactions in a similar way as Bitcoin.

As mentioned before, the nodes are operated by large commercial banks approved by the Federal Reserve Banks and validate Fedcoin transactions between users. These entities also use Fedcoin for their own payments. As an incentive for operating these nodes, those responsible for validation will be able to collect transaction fees. If consensus is reached by these nodes, the approved Fedcoin transaction is

¹²⁹ Comm. on Paymts. & Mkt. Infrastructures, *supra* note 13, at 10.

¹³⁰ Other Federal institutions have demonstrated vulnerability to cyberattacks. *See, e.g.*, Jim Sciutto, *OPM Government Data Breach Impacted 21.5 Million*, CNN (July 10, 2015), <https://www.cnn.com/2015/07/09/politics/office-of-personnel-management-data-breach-20-million/index.html> (“Government investigators now believe that the data theft from the Office of Personnel Management computer systems compromised sensitive personal information, including Social Security numbers, of roughly 21.5 million people from both inside and outside the government, the government announced Thursday.”).

¹³¹ Brainard, *supra* note 37.

¹³² Comm. on Paymts. & Mkt. Infrastructures, *supra* note 13, at 10.

¹³³ NOTE: Among other things, Fedchain would overcome Bitcoin’s technological constraints of scalability.

recorded on the Fedchain. Although Fedchain is a public ledger, only transaction amounts and party addresses are viewable.

Option 2: Fedcount

Fedcount offers a new account-based money created and held by the Federal Reserve Banks. Unlike master accounts, Fedcounts would be generally accessible to the nonbank public for holding electronic money. Fedcounts would hold electronic money for all users who register with their Federal Reserve Bank. To prevent fraud and enable instantaneous verification, registration with a Federal Reserve Bank and login to Fedcount require fingerprint and/or facial recognition, which is already technologically feasible with smartphones. After successful login, users can review the account balance and transaction history of the Fedcount but nothing else. The development of expanded interfaces for payments and other functions would have to be provided by private sector firms, such as commercial banks. Such institutions would administer the relevant services to make Fedcount suitable for a user's needs in exchange for fees. Integral functions to develop include the interfaces to initiate payments and to review more detailed transaction summaries. Other functions would include internet coverage, periodic statements, and customer support.

Although a commercial bank might administer Fedcounts, Fedcounts would be distinct from a deposit account at a private bank because Fedcounts would be directly held at a Federal Reserve Bank and belong to the account holder (*i.e.*, the user). The relevant Fedcount administrator would only be responsible for offering services associated with the Fedcount. Therefore, unlike conventional bank accounts, commercial banks providing Fedcounts would not be able to conduct lending with money housed within Fedcounts. Moreover, money stored in Fedcount represents a liability of the relevant Federal Reserve Bank, not of the Fedcount administrator. Thus, according to the analysts, even if the bank administering services to the Fedcount were to fail, the Fedcount would remain safe with the Federal Reserve Bank.

Option 3: Neither

For the purposes of practicably advancing payment efficiencies and monetary policy implementation, neither Fedcoin nor Fedcount would be superior to maintaining the existing infrastructure supporting cash. It is therefore prudent to continue with the current system for the foreseeable future.

Briefing Questions

Having examined the proposals, please review the materials included in the attached Appendix and prepare to brief the Director. In particular, the Director is eager to know your thoughts as to the following:

1. What are the comparative strengths and weaknesses of Fedcoin and Fedcount? In what ways can these proposals be improved?
2. What would be the likely reaction from financial sector stakeholders to these proposals? Consider the following four examples:
 - **Ames Bank** is a depository institution located in Cambridge, Massachusetts. Its business primarily consists of making loans to businesses, for which much of the funding is done through deposit-taking.
 - **BitBank** is a cryptocurrency company that supports and develops wallets for Bitcoin and Bitcoin-derived currencies. Its wallets do not have compatibility with other types of cryptocurrencies.
 - **The Zcash Company** supports and develops Zcash, which is a privacy-protecting digital currency. Zcash features zero-knowledge proofs that allow the payee to prove the validity of a transaction without revealing information about the transaction itself. This allows transactions to be fully shielded from being traced within the public blockchain, thereby completely protecting the users' privacy.
 - **Libra** is a blockchain-based digital currency, proposed by Facebook, and administered by the Libra Association. The currency and network are still in development.
3. Consider the following proposals made by our IT specialists:
 - **For Fedcoin** – IT specialists claim that Fedchain's cybersecurity capabilities could be enhanced by moving from a permissioned network of nodes to a permissionless network of nodes. They argue that a permissionless network would offer more robust operational resilience as the consensus mechanism could continue operating should any node become unavailable or compromised. What are the benefits and concerns?
 - **For Fedcount** – IT specialists insist that Fedcount has the technological capability of providing more comprehensive services and greater financial inclusion for users if the Federal Reserve assumed control over administering Fedcount's payment and customer services. What are the benefits and concerns?
4. Although cash is deemed legal tender, Federal law does not obligate a private business to accept cash payments. Businesses retain discretion to accept payment in whatever form they prefer. Take for example, bus lines that refuse pennies or convenience stores that refuse high-denomination bills.¹³⁴ Other countries such as China and France take a different approach, making it generally unlawful for payees to refuse notes and coins with the status of legal tender. What

¹³⁴ Treas. Dept., *Legal Tender Status*, U.S. Dep't of Treasury (Jan. 4, 2011), <https://www.treasury.gov/resource-center/faqs/currency/pages/legal-tender.aspx>.

are the benefits and drawbacks of these two approaches as applied to CBDC? How likely is the U.S. approach to change to this alternative approach? How should society weigh the payer's right to choose between payment methods with that of the payee's?

5. As the readings suggest, many closely associate anonymity with privacy. Yet, the two are distinct. Information can be private but not anonymous, such as transaction logs with personally identifying information safeguarded by a bank; likewise, information could be anonymous but not private, such as the sharing or disclosure of spending patterns aggregated across large numbers of users. Is this a meaningful distinction? If so, how does it pertain to the conversation about CBDC?
6. How does CBDC, whether by its nature or by design choice, compare with the attributes of cash?
7. Circulation and usage of U.S. notes extends beyond U.S. citizenship and territoriality. On the other hand, eligibility for master accounts with Federal Reserve Banks is limited to U.S. entities with a few exceptions. What legal and policy considerations would be implicated if CBDC access is granted internationally or restricted nationally? If the latter, should any controls be in place?
8. How would you rank the three options for purposes of payment efficiencies and monetary policy implementation?
 - Would your conclusion change if the motivation for developing CBDC was instead to advance (i) financial stability or (ii) financial inclusion (see footnote 22)? Is either financial stability or financial inclusion a pressing objective for the Federal Reserve System?

Appendices

Speech by Governors of the Federal Reserve Board

- Item 1: Remarks by Gov. Lael Brainard, Bd. of Governors of the Fed. Reserve Sys., Cryptocurrencies, Digital Currencies, and Distributed Ledger Technologies: What Are We Learning? (May 15, 2018), <https://www.federalreserve.gov/newsevents/speech/brainard20180515a.htm>.
- Item 2: Remarks by Gov. Lael Brainard, Bd. of Governors of the Fed. Reserve Sys., Digital Currencies, Stablecoins, and the Evolving Payments Landscape (October 16, 2019), <https://www.federalreserve.gov/newsevents/speech/brainard20191016a.htm>.

Congressional Hearing – The Future of Money: Digital Currency, Hearing Before the Subcommittee on Monetary Policy and Trade of the Committee on Financial Services, U.S. House of Representatives (July 18, 2018).

- Item 3: Transcript Excerpts of the Prepared Statement of Eswar S. Prasad

Casebook – MICHAEL S. BARR, HOWELL E. JACKSON AND MARGARET E. TAHYAR, FINANCIAL REGULATION: LAW AND POLICY (2d ed. 2018).

- Item 4: Excerpts of Chapters 1.2 and 9.1

IMF Publications

- Item 5: Christine Lagarde, Managing Director, IMF, Winds of Change: The Case for New Digital Currency (Nov. 14, 2018).
- Item 6: TOMMASO MANCINI-GRIFFOLI ET AL., IMF, CASTING LIGHT ON CENTRAL BANK DIGITAL CURRENCY, IMF STAFF DISCUSSION NOTE (Nov. 2018).

BIS Report

- Item 7: BANK FOR INT'L SETTLEMENTS, CENTRAL BANK DIGITAL CURRENCIES (2018), <https://www.bis.org/cpmi/publ/d174.pdf>.
- Item 8: CHRISTIAN BARONTINI AND HENRY HOLDEN, BANK FOR INT'L SETTLEMENTS, PROCEEDING WITH CAUTION – A SURVEY ON CENTRAL BANK DIGITAL CURRENCY (2019), <https://www.bis.org/publ/bppdf/bispap101.pdf>.

Academic Articles

- Item 9: Itai Agur, *Central Bank Digital Currencies: An Overview of Pros and Cons*, in DO WE NEED CENTRAL BANK DIGITAL CURRENCY? (2018).
- Item 10: Aleksander Berentsen and Fabian Schär, *The Case for Central Bank Electronic Money and the Non-case for Central Bank Cryptocurrencies*, 100 FED. RES. BANK OF ST. LOUIS REV. 97 (2018).
- Item 11: Charles M. Kahn, Francisco Rivadeneira and Tsz-Nga Wong, *Should the Central Bank Issue E-Money?* (Oct. 2018), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3271654.
- Item 12: Robert C. Hockett, *Money's Past Is Fintech's Future: Wildcat Crypto, the Digital Dollar, and Citizen Central Banking* (Dec. 11, 2018), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3299555.
- Item 13: Kenneth Rogoff, *Dealing with Monetary Paralysis at the Zero Bound*, 31 J. OF ECON. PERSPS., Summer 2017, at 47 (2017).

- Item 14: Jeffrey Rogers Hummel, *The War on Cash: A Review of Kenneth Rogoff's The Curse of Cash*, 14 ECON. J. WATCH, May 2017, at 138.
- Item 15: Morgan Ricks, John Crawford and Lev Menand, *A Public Option for Bank Accounts (or Central Banking for All)* (Vanderbilt Univ. Law Sch., Research Paper No. 18-33, 2018), <https://ssrn.com/abstract=3192162>.

News Articles

- Item 16: Izabella Kaminska, *When the State Takes on the Digital Float, the State Takes on the Risk*, FIN. TIMES (Jan. 10, 2019), <https://ftalphaville.ft.com/2019/01/10/1547096400000/When-the-state-takes-on-the-digital-float--the-state-takes-on-the-risk/>.
- Item 17: Nouriel Roubini, *Central Bank Digital Currencies Will Destroy Cryptocurrencies*, ING THINK (Nov. 19, 2018), <https://www.project-syndicate.org/commentary/central-banks-take-over-digital-payments-no-cryptocurrencies-by-nouriel-roubini-2018-11>.
- Item 18: Simon Scorer, *Central Bank Digital Currency: DLT, or not DLT? That Is the Question*, BANK UNDERGROUND (June 5, 2017), <https://bankunderground.co.uk/2017/06/05/central-bank-digital-currency-dlt-or-not-dlt-that-is-the-question/>.
- Item 19: James Grant, *Hostage to a Bull Market*, WALL ST. J. (Sept. 9, 2016), <https://www.wsj.com/articles/hostage-to-a-bull-market-1473456611>.

International Reports

- Item 20: Center for the Fourth Industrial Revolution, *Central Bank Digital Currency Policy-Maker Toolkit*, World Economic Forum (Jan. 2020), http://www3.weforum.org/docs/WEF_CBDC_Policymaker_Toolkit.pdf.