The Future of Money: Digital Currency

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Chair Barr, Ranking Member Moore, and Members of the Subcommittee on Monetary Policy and Trade, thank you for inviting me to testify at this hearing on "The Future of Money: Digital Currency."

The convenience of electronic transfers has led to a decline in the use of cash relative to commercial bank deposits in many countries around the world.[2] This is particularly true in countries where systems for transferring commercial bank deposits are more advanced. Sweden is perhaps the best example of this. Its mobile payment system, Swish, has been adopted by over 60 percent of the population and the use of cash in transactions has fallen to 2% by value.[3] Countries around the world are introducing faster payment systems including the recently launched Real Time Payments platform by the Clearing House in the United States. At the same time Paypal, Venmo and other private mobile payment platforms continue to improve the convenience and speed of person-to-person and retail payments by leveraging conventional financial market institutions and infrastructures. It seems likely that the use of cash for transactions will continue to fall and it is worth noting that there is tipping point at which even if customers seek to use cash, businesses and banks will not want to deal with it.[4]

What happens then? One possibility is that people will be content to transact primarily in commercial bank deposits and things will be business as usual with a much smaller cash component to the monetary base.[5] Another possibility is that consumers will demand direct

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[1] Former Vice President, Federal Reserve Bank of New York, 2013-2015.
[2] See E. Prasad, "Central banking in a digital age: stock-taking and preliminary thoughts," Hutchins Center on Fiscal & Monetary Policy at Brookings, Apr. 2018.
[3] https://www.instapay.today/tracker/sweden-swish/, https://www.worldpaymentsreport.com
[4] The percentage of transactions using cash in the United States by value/volume fell from 14%/40% in 2012 to 8%/31% in 2016. See https://www.frbsf.org/cash/publications/fed-notes/2014/april/cash-consumer-spending-payment-diary/.
[5] It is unlikely and it would be undesirable for cash to disappear completely in the near future. First, some people do not have access to a bank account, credit or debit cards or electronic payment platforms and

access to some form of digital central bank issued money as a replacement for cash. A third possibility is that consumers will turn to privately-issued cryptocurrencies. Privately-issued cryptocurrencies use decentralized networks of computers to facilitate remote peer-to-peer exchanges in the absence of trust between the parties and without the need for an intermediary. From the report on Digital Currencies from the Committee for Payments and Market Infrastructures:

> Typically, a payer stores in a digital wallet his/her cryptographic keys that give him/her access to the value. The payer then uses these keys to initiate a transaction that transfers a specific amount of value to the payee. That transaction then goes through a confirmation process that validates the transaction and adds it to a unified ledger of which many copies are distributed across the peer-to-peer network." (p. 5)[6]

In this regard, I use Bitcoin as the leading example. Other, so-called altcoins (eg Litecoin, Zcash, Monero) are captured by my remarks.[7]

These options are not mutually exclusive, nor are they independent. The adoption rate of bitcoin, will depend not only on its performance as a money, but also on the alternative forms of digital money (if any) that the central bank provides. If consumers perceive that they have inadequate access to a cash-like medium of exchange, then they may be more inclined to turn to alternatives. On the other hand, if the central bank offers a digital form of central bank money to the public with sufficient cash-like properties, then perhaps this will appease those who miss cash.

Central banks are currently evaluating numerous options for digital currencies, not just in response to the shift away from cash, but also for meeting core objectives and the enhancement of financial market infrastructures. Ongoing proofs-of-concept by central banks and private partners consider the use of central bank cryptocurrencies in wholesale systems only. These

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cash allows the only form of settlement that can occur during a power outage. Second, cash is the only form of payment that cannot be disrupted by a cyberattack. Finally, if there were no cash, then it would be unclear to the general public what commercial bank deposits represent, since there would be nothing for deposit account holders to convert them to. Ken Rogoff, who suggests eliminating high denomination notes in order to reduce crime and tax evasion, argues that eliminating cash altogether "could disrupt common social conventions for using money, possibly in unexpected ways." See p. 451 of K. Rogoff, "Costs and benefits to phasing out paper currency," *NBER Macroeconomics Annual* 29(1), 2015.

[6] Committee on Payments and Market Infrastructures, "Digital Currencies," November 2015.

[7] These altcoins function similarly to bitcoin and some have enhanced privacy features. There are also cryptocurrencies whose primary purpose is not to provide a cash substitute, but rather to facilitate other operations over distributed ledger platforms. Ether is a cryptocurrency that is native to the Ethereum platform. Its primary purpose is to serve as "gas" that fuels the execution of smart contracts. These currencies can also perform functions of money.

applications are driven by efficiency and cost considerations and have minimal monetary policy implications.

In what follows, I will begin by focusing on the merits of a widely accessible, retail-oriented central bank cryptocurrency that could be used by the public for person-to-person and retail transactions. I will then return to a discussion of wholesale applications.[8]

The initial inspiration for a retail central bank cryptocurrency came from blog posts by JP Koning and Sina Motamedi.[9] A retail central bank cryptocurrency could transact like bitcoin. However, instead of having a fixed money-supply rule the Federal Reserve would control the creation and destruction of these coins. Crucially, there could be one-for-one convertibility with cash and reserves, and hence a retail central bank cryptocurrency would not suffer from the high price volatility that undermines the usefulness of bitcoin as a store of value and medium of exchange.[10]

The Federal Reserve could choose to implement a cryptocurrency on a permissioned blockchain, which means transaction verification could be performed by vetted actors who are accountable for their actions, without costly proof-of-work. This could mitigate the objection raised by Michael Bordo and Andrew Levin that transaction verification in "token-based" cryptocurrencies is inherently expensive and decentralized fixes (eg replacing "proof of work" with "proof of stake") may be unacceptable.[11] Significant progress in this direction is reflected in the RSCoin mechanism proposed by George Danezis and Sarah Meiklejohn.[12] Another advantage of this hybrid approach, where trade is decentralized but validation is centralized, is that it provides settlement finality. Principle 8 of the Principles for Financial Market Infrastructures requires that "An FMI should provide clear and final settlement…" (p. 64)[13] Lack

[8] Payments economists divide payments into retail and wholesale. Retail payments are relatively low-value payments made by the general public. In contrast, wholesale payments are large-value and high-priority payments such as interbank payments. The distinction might become less relevant in a world with central bank cryptocurrencies. My usage here reflects the type of payments that the central bank cryptocurrency primarily targets. See the taxonomy of money provided in M. Bech and R. Garratt, "Central bank cryptocurrencies," *BIS Quarterly Review*, September 2017.

[9] See J. P. Koning, "Fedcoin" blogpost, 2014 and S. Motamedi, "Will bitcoins ever become money? A path to decentralised central banking, blogpost, 2014. See also Koning, "Fedcoin: A central bank issued cryptocurrency," R3 Reports, November 2016.

[10] Price volatility undermines an object's usefulness as a medium of exchange in two ways. Volatility on the downside makes recipients less likely to accept it. While volatility of the upside, such as was experienced during the bitcoin price surge that occurred at the end of 2017, make people unwilling to spend it. See Bech and Garratt for an illustration of bitcoin's price volatility.

[11] See M. Bordo and A. Levin, "Central bank digital currency and the future of monetary policy," Economics Working Papers 17104, Hoover Institution, Stanford University, 2017.

[12] See G. Danezis and S. Meiklejohn, "Centrally banked cryptocurrencies," 2016.

[13] See Committee on Payment and Settlement Systems, "Principles for financial market infrastructures," April 2012.

of settlement finality in permissionless systems was one of the objections to bitcoin raised by the Bank for International Settlements in its 2018 Annual Economic Report.[14]

Proposals to increase access to digital central bank money are not new. Nobel Laureate James Tobin proposed giving the public access to "deposited currency accounts" at Federal Reserve banks over three decades ago.[15] Balances in deposited currency accounts would actually be central bank money, as opposed to commercial bank deposits which are redeemable for central bank money (currently in the form of cash). These accounts could be administered by the central bank or offered through commercial banks that hold these funds in segregated accounts.[16]

If deposited currency accounts were not considered to be a good idea in the 1980s, why might central bank cryptocurrencies be a good idea today (or at least in the future)? A number of things have changed since Tobin's proposal. As I mentioned previously, cash use has declined. We have also been through a major financial crisis which may have changed some people's attitudes toward commercial bank deposits. Finally, technological advancements offer the potential for issuing digital central bank money in a new way with enhanced features.

In regards to the last development, I offer two examples. First, the peer-to-peer aspect of cryptocurrencies could allow central banks to provide a digital money with anonymity properties similar to those of cash. Whether or not the central bank would want to do this is a complicated issue that requires balancing legitimate demands for individual privacy against concerns related to tax evasion and other criminal activities.[17] The potential for illegal behavior is not unequivocally increased by cryptocurrencies. Cryptocurrencies are easier to transact in large quantities than cash, but they are also more traceable. Second, there is the potential to improve upon cash by creating what advocates of cryptocurrencies call "programmable money." Programmable money allows trading parties to hardwire the terms and conditions of trades into their transactions so that they may be executed upon fulfilment of the conditions without relying on third parties. This is particularly useful for transactions that span multiple legal jurisdictions.

Any decision to implement a retail-oriented central bank cryptocurrency would have to balance potential benefits against potential risks. A common objection to expanding access to

[14] See Bank for International Settlements, "Cryptocurrencies: looking beyond the hype" Annual Economic Report, 17 June 2018.
[15] See J. Tobin, "Financial innovation and deregulation in perspective," *Bank of Japan Monetary and Economic Studies*, 3(2), 1985 and Tobin, "The case for preserving regulatory distinctions," in Proceedings of the Economic Policy Symposium, Jackson Hole, Federal Reserve Bank of Kansas City, 1987.
[16] See Tobin, 1987 and B. Dyson and G. Hodgson, "Digital Cash: Why Central Banks Should Start Issuing Electronic Money," 2017.
[17] Sweden's Riksbank outlined options it is considering for an e-Krona and one of these, a stored value technology, allows transaction anonymity. See "The Riksbank's eKrona Report", Report 1, September 2017.

central bank money is that it could disintermediate banks, however it is also plausible that it could produce healthy competition. The risk of excessive disintermediation could be mitigated by making the central bank cryptocurrency more like cash and less like commercial bank deposits. In a 2016 speech Ben Broadbent, Deputy Governor for Monetary Policy at the Bank of England stated his opinion that if a central bank digital currency "bore no interest and came without any of the extra services we get with bank accounts – people would probably still want to keep most of their money in commercial banks."[18]

I now return to the wholesale applications of central bank cryptocurrencies.[19] The motives for considering central bank cryptocurrencies in wholesale applications center around new applications of "distributed ledger technology." The goal here is to leverage aspects of the decentralized structure underlying cryptocurrencies to enhance or reconfigure existing financial market infrastructures. Initial use cases were limited to large value payment systems, but work has since expanded to include cross-border payments, securities clearing and settlement and trade finance.[20] What is common to many of these applications is the need for a settlement token that is native to the platform. Principle 9 of the Principles for Financial Market Infrastructures states that "An FMI should conduct its money settlements in central bank money, where practical and available." (p. 67) As such, proponents of these new systems would like to see the tokenization of central bank money. One possibility would be the creation of an entirely new form of restricted-use central bank money, a central bank issued token, that can only by traded by participants on these closed systems.[21] However, the Bank of Canada came up with an alternative concept that achieves the same outcome without adding a new component to the monetary base.

In Project Jasper, Canada's proof of concept for a large value payment system on a distributed ledger, the project team utilized the concept of a *digital depository receipt* or DDR. The approach was to issue tokens on a distributed ledger platform that represented claims to participants' settlement balances at the central bank. With the proper legal structure in place, transfers of the tokens on the ledger could represent a final and irrevocable transfer of central

[18] See B. Broadbent, "Central banks and digital currencies", speech at the London School of Economics, March 2016.
[19] For a discussion on the distinction between retail and wholesale central bank cryptocurrencies see R. Garratt, "CAD-coin versus Fedcoin," R3 Reports, November 2016.
[20] See D. Mills, K. Wang, B. Malone, A. Ravi, J. Marquardt, C. Chen, A. Badev, T. Brezinski, L. Fahy, K. Liao, V. Kargenian, M. Ellithorpe, W. Ng and M. Baird, "Distributed ledger technology in payments, clearing, and settlement," Finance and Economics Discussion Series 2016-095. Board of Governors of the Federal Reserve System; European Securities Markets Authority, "The distributed ledger technology applied to securities markets", Report 7 January 2017; and E. Benos, R. Garratt and P. Gurrola-Perez, "The economics of distributed ledger technologies for securities settlement", Bank of England Staff Working Paper No. 670, August 2017.
[21] A precedent is the 1934 gold certificate issued by the Federal Reserve in the United States for the sole purpose of making interbank payments.

bank money. These tokens were passed from node to node in the system and at the end of the process the owners of the DDRs redeemed them at the central bank for an equivalent value in settlement account balances.

This idea can be implemented privately, in an almost equivalent fashion. Cooperating parties can set up a closed network in which members trade tokens representing claims on central bank money in an external private account. An example of a private collection of financial institutions that is attempting this type of arrangement is the group of six global banks behind Utility Settlement Coin.[22] By creating a special purpose 100% reserve bank or through the establishment of a special joint account the money backing the value represented on a distributed ledger can be free of credit risk.[23]

DDR schemes leverage advantages of decentralized trade, but they rely on special actors within the system, either a central bank, or a designated authority or group, who holds money off ledger and plays a significant role in the transaction verification process. Thus, these wholesale systems also avoid costly proof of work. So far, central banks have not seen significant added-value to these systems over conventional systems, however central banks continue to experiment with broader financial applications where prospects for added-value are greater.[24]

In conclusion, I believe that the Federal Reserve will, at some point in the future, need to respond to the disappearance of cash and I have given some reasons why it might consider offering some form of retail-oriented central bank cryptocurrency. There are, however, many issues related to the viability and security of this technology that need to be fully resolved before adoption. Moreover, a much deeper understanding of the monetary policy and financial stability issues is needed. On the wholesale side, the DDR concept allows financial market infrastructures to build clearing and settlement features onto distributed ledger platforms by leveraging conventional central bank accounts without introducing a new category of central bank money.

Thank you again for the opportunity to testify before you today. I would be happy to answer any questions.

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[22] https://www.ft.com/content/20c10d58-8d9c-11e7-a352-e46f43c5825d?mhq5j=e5

[23] Joint Accounts currently offered to financial market infrastructures by the Federal Reserve could potentially be used for this purpose.

[24] Evaluations of proof-of-concepts for a large value payment systems are found in J. Chapman, R. Garratt, S. Hendry, A. McCormack and W. McMahon, "Project Jasper: Are Distributed Wholesale Payment Systems Feasible Yet?" Bank of Canada *Financial System Review*, June 2017 and Monetary Authority of Singapore, "Project Ubin Phase 2, Re-imagining Interbank Real-Time Gross Settlement System Using Distributed Ledger Technologies," November 2017.