Preface

We are amid a Big Bang, an impressive explosion of new concepts and initiatives regarding money, payments, and finance. How do we grasp this incredible number of ideas and ventures? Its diversity and complexity require an approach to it from different perspectives, and this book is a solid illustration of how to apply different viewpoints and disciplines. I leave it to the reader to delve into the soul of each reflection, interpretation, and proposal about what is happening through the economic and legal literature views. I hope to ignite the reader's interest in providing the thoughts of a former central banker.

One interesting perspective is analysing what is happening in the payment system as a case of liberalisation. This is the most crucial liberalisation process after introducing competition in China and the other planned economies. There are many lessons from past liberalisation processes of different economic sectors that can be applied to the current disruption of the monetary system. Let me explain.

I Seventy years of structural reforms

The legacy of the first half of the 20th century was disastrous from the perspective of economic regulation. In some countries, the temptation of the centrally planned economy implemented systems where the State has a dominant role in the functioning of the economy. Communism, fascism, war, and even post-war governments gave the State excessive power that stifled competition and deeply worsened the prosperity of all of us. Since then, and over the last seven decades, the roles of the State and the Market have been reassigned through numerous structural reforms that have had spectacular effects in increasing the welfare of most citizens worldwide.

The first and most important of these regulatory changes was the GATT's liberalisation of international trade. Further, the list of regulatory changes is extensive: the privatisation of public companies; the liberalisation of regulated or monopolised sectors such as telecommunications and transport; the introduction of 'flexicurity' in labour markets; the creation of the internal market in the European Union; and capital flows liberalisation, to name the more relevant. No one should ignore the great transformation at the end of the 20th century in most former communist countries, as they introduced market mechanisms for producing goods and services. All these structural reforms have introduced freedom and competition to the economic decisions of citizens and companies by devoting to the State the adoption of policies restricted to general interest objectives not fully served by the Market. Governments of diverse ideologies have adopted these structural reforms, such as the conservative Margaret Thatcher or the socialist party in Spain. In the United States, Republicans defended deregulation, and Democrats initiated several sector liberalisations. In recent decades, the most crucial Market reform has been led by the Chinese Communist Party. All these governments were not guided by dogmatism but by pragmatism. They did not defend the Market and the State for ideological reasons but just decided to leave to the Market what it knows best and exit the State from what it knows worst.

Nowadays, reassigning the roles of the State and the Market in money, payments, and other financial activities is opening. Indeed, the State has heavily intervened in activities such as payments and financing. And the creation of money, which should be public, is in private companies' hands. The fragility of private means of payment has been the primary source of financial instability over the last centuries. The State had to intensely protect and regulate banking activities to avoid continuous and severe episodes of instability. This accumulation of protections and privileges has turned activities such as payments into a regulated monopoly. And, paradoxically, regarding money creation, the State has lost space. Physical money is public, but the only digital money accessible to all citizens is bank deposits which are private money. Digital public money—central bank reserves—can only be used by the banks themselves.

This bizarre distribution of roles between the State and the Market has lasted a long time because there were no alternatives to bank deposits. However, over the last decade, new technologies have arisen so that we can reassign the role of the State and the Market in money and payments regulation. Today there are alternatives. We do not need to use fragile financial assets, such as bank deposits, as a means of payment.

Three proposals for digital money aside from bank deposits have appeared in recent years. In chronological order, we find the self-styled cryptocurrencies, the digital currencies issued by central banks (CBDC), and the most recent proposal is 'stablecoins.' We are in the middle of a debate, and it would be pretentious to predict what the role of these currencies will be in the future. Still, we can suggest what would be the most reasonable lines of structural reform of money, payments, and other banking activities.

II Structural reform characteristics

Let us, therefore, examine the changes in the regulation of money and payments as if they were one more episode of the structural reforms of recent decades that have reassigned the roles of the State and the market in sectors that the State strongly regulates. Each of these economic sectors is different from the others, and undoubtedly, the financial industry is different. However, it shares some characteristics that can be used to reform money and payments.

The most important feature of structural reforms is known as *unbundling*. To introduce competition in regulated sectors, we must distinguish monopolistic activities from those performed with the competition. Monopolistic activities must be regulated and separated from those supplied in competition by different private companies. Examples of 'unbundling' in the telecommunications reform are the separation between networks and services; the air transportation reform separates airport management from airlines.

A second tool is to *maximise competition in liberalised activities*. To achieve this, we must remove all privileges from the current companies and the rules regulating their economic conduct. For this reason, it is common to speak of *deregulation*. However, it would be better to talk of *reregulation*. Although the State ceases to intervene in the economic conduct of economic actors, its regulatory action is even more necessary to maintain the integrity and functioning of markets, protect users, prosecute cartels, prevent the formation of monopolies, protect data, defend privacy, and so on. With competition, goods and services prices fall, increasing in quality. The main virtue of competition is, nevertheless, innovation. The most valuable thing about competition is that private initiative strives to create goods and services that do not still exist but will become highly appealing to consumers and users. When the telecom sector was liberalised, no one would have imagined the positive impact of smartphones.

Finally, the third characteristic of a structural reform that tries to eliminate protections and privileges to get competition is *to find an adequate transition formula* to go from a heavily intervened

system to a system where the free market works.

Below we will examine the structural change that we are experiencing as an episode of liberalisation like those that have occurred in recent decades in other sectors of the economy. We will highlight the necessary unbundling of activities, the complete competition dismantling of all protections and monopolistic privileges, and the design of an adequate transition from the current to the new system.

III Stability and competition

On the one hand, we have a financial instability problem in our current monetary and banking system. That is a consequence of the means of payment we use—bank deposits—which are a risky asset. On the other hand, there is a lack of competition in payment services due to the privileges, protections, and intrusive regulations necessary to avoid the stability problems created by that unsafe money. These problems—instability and lack of competition—are intimately related to the current system. It is impossible to introduce competition in the services banks provide because this would immediately damage their profitability and solvency, leading to bankruptcy and a collapse of money flows. But while the current monetary system has not changed, most means of payment continue to be assets—bank deposits—with credit and liquidity risk. The existing corpus of protections, privileges, and intrusive regulation is fully justified. Those barriers to competition are indispensable to avoid crises in a system with no alternatives to bank deposits. This accumulation of protections for banks makes it impossible to open competition in payment services to any company other than banks. It has been necessary to avoid money crises. However, the new technologies allow us to unbundle activities such as money, payment services, and other financial services. If we unbundle these activities, we can have safe money, not fragile with no need for protection and privileges, such as 'lender of last resort,' the guarantee of deposits, the rescue of banks with taxpayers' money, or the vast collection of prudential regulations. That is why the structural change in money and payments will be a double reform. On the one hand, we will achieve safe money and, on the other, a liberalisation of banking activities.

A reform was adopted in the 19th century with physical money and banknotes. Indeed, in the first half of that century, in many countries, most banknotes were issued by private banks, and because the banks were not so protected, they were perpetually in crisis. At first, it may seem paradoxical that having public money would be an indispensable condition for competition in payment services and other banking activities, but this is not the case. Sovereign money has characteristics that make it necessary to compete in payment services. In the first place, central bank money does not need State protections or privileges; therefore, all service providers compete on a level playing field. That is important to make the competition happen. Second, the State facilitates the functioning of the market by deciding on a unit of measurement. When the State chooses the units of weight measurement, this is also observed in the goods market. Leaving the units of measurement to private competition does not favour and harm the operation of the market. If there are different private means of payment, citizens are forced to study the solidity of the various issuers. One characteristic of money is *uniformity*.

Of course, there is a way to make various private currencies look uniform. It can be achieved if the State ensures and protects those different means of payment so citizens perceive them as single public money. That happened regarding bank deposits, which, as private means of payments with varying solvency levels, are definitively considered uniform and public money. For centuries, the State needed to protect banks and grant them privileges to make deposits appear equally safe. The new technologies' advantage is that they separate money from payment services. The State ensures that money is unique and safe without giving privileges to anyone,

and the Market provides many competitors in activities that should be purely private, such as payment services.

Money creation is wholly separated from the provision of payment services when unbundling money from payment services. As in other sectors that have been liberalised, this unbundling is essential for competition to occur. And collapses in payments disappear. Instead of instability and lack of competition, we will have stability and competition simultaneously.

IV Competition and innovation

It is necessary to remove all the protections and privileges that regulated companies had and the regulations that constrained their activity to maximise competition in previously regulated sectors. It is essential to *level the playing field* so new competitors and incumbents can compete on equal terms without State support. In the case of banking activities, it would be necessary to eliminate the many privileges that banks enjoy, such as those of lender of last resort, privileged access to digital money issued by central banks, deposit guarantees, or bailing out the banks with taxpayer money. Likewise, all prudential regulations may be repealed because they would no longer be necessary since the money would be a safe asset. The competition will reduce the prices of transactions and their unfounded slowness in a digitised world. But the most positive effect of competition, likewise in other sectors such as telecommunications, will be the creation of innovative products and services. For sure, the innovation will not arise exclusively in the payment system but also in other financial activities that will emerge when the banking monopoly ends. One of the difficulties in convincing public opinion of structural reforms for the competition is that the most important benefits are unknown. We can talk about what exists but not what still needs to exist: innovation. We are still determining what will produce innovation; we only know that if there is competition, there will be innovation.

V The transition to competition

The third essential element in all liberalisation policies is the design of an adequate transition bridge from a protected and strongly regulated system to a system based on free-market rules. No liberalisation policy, no method of introducing competition, is carried out without giving protected companies time to transform to provide their services subject to market discipline, without state support. For example, in international trade liberalisation agreements, the transition was done through gradual calendars to progressively dismantle national producers' protections and privileges. In other sectors, various categories of aid or subsidies were transitorily provided to the old companies so that they could transform and compete in the new system or shut down their businesses in an orderly manner. The transition is a critical phase of any liberalisation policy because introducing competition reallocates productive resources. Capital, human resources, and management capacity to provide low-quality, high-priced services must be employed to offer better and even new services that those companies did not previously present. New and vested private interests do not help design adequate transitions in money and payments.

On the one hand, the new entrants have no interest in a transition phase. They want immediate liberalisation because they are perfectly equipped to provide users with their highest quality and lowest priced services. On the other hand, the incumbents are interested in delaying the transition or approving regulations that put all kinds of difficulties on the new entrants. But these two ways to go from the old to the new system are unacceptable.

The first procedure, having no transition process, letting the free market allow the new businesses to succeed and the old ones to go bankrupt, is an economic waste regardless of the

social effects. Much of their capital resources, management capacity, and workers would be lost by not allowing the incumbents to transform themselves and use those resources to offer their services in competition. The second transition method, delaying the change or hindering new competitors, is unacceptable because users need to obtain the advantages of the best services. The banks are not encouraged to transform themselves to provide those services with the whole competition. Unfortunately, some central banks are considering limiting transactions with digital public money so that commercial banks are not harmed. This kind of transition of abusing the new digital money is a daydream of wanting to liberalise a sector and introduce competition but do it without dismantling the monopoly. It is unrealistic because it will be challenging for public opinion to tolerate governments maintaining the privileges and protections for commercial banks when people see safer money possibilities that only need some of those privileges. It is not reasonable to reform the current system without addressing transition problems. But neither does it make sense to harm the use of public digital money to avoid problems for banks. The essential piece of a well-designed transition is helping commercial banks transform. They must be temporarily enabled to compete with new competitors in different banking activities (payments and loans) without the need for perpetual state support or privileges.

VI Hope

It is fair to recognise that the current debate on structural changes in money, payments, and banking started in the so-called 'crypto world.' They presented technological changes that could improve the efficiency of the financial system. They announced a radical change in the role of the State and individual decisions, as well as in the functions of central banks and intermediaries. Those cryptos were wrong to exaggerate, say that the State would disappear, that intermediaries would no longer be necessary, and that there would no longer be inflation problems because the central banks would not be able to increase the quantity of money. But certainly, we need to reach this millenarian vision to see a substantial change in the role of the State and individual decisions in the financial system. We must recognise that we will continue to have some of the problems that we currently have with the fragility of money, the inefficiency of monetary policy, and the lack of competition in designing a sound system of money, payments, and financial activities. Economic policies are more than just the result of correctly assessing the problems and benefits of the different regulations and choosing the most appropriate ones. The private interests many have in adopting the regulatory changes also count. But let's hope that progress will be made in more stability and competition because payments and the financial system play a vital role in the economy. A good reform could significantly increase productivity, output, and state revenues. Today there is a broad consensus that the essential policies fight climate change and correct inequalities. These policies are critical to the economy's growth in the long term, but in the short term, they reduce private income growth and require many public resources. For this reason, the reform of money and banking activities is a complementary policy with these two, to the extent that competition increases productivity and output in the short term and provides an increase in public resources that could be used to subsidise those policies without increasing deficits or public debt.

Let's hope so.

Miguel Fernández-Ordóñez

Part I

Overview

1 A History of Central Bank Digital Currency and the Money Monopoly

Franklin Noll[1]

1 I finished writing this chapter before I started working at the Federal Reserve Bank of Kansas City. It is important to note that the thoughts expressed in this chapter are my own and may not match the opinions of my colleagues at the Bank.

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1.1 CBDCs defined

What do we mean when we talk about a CBDC? Here, we run into an imprecision in the definition. The term first appeared in 2015,[2] even though the idea had been discussed for years before. As early as 1985, James Tobin talked about something he called 'deposited currency.' This currency would be electronic 'store-of-value embodiments of a monetary unit of account...supplied by the central government' either directly or through traditional bank accounts.[3] Around the same time (the late 1980s), Finland experimented with electronic money and smart payment cards. In 1991, the Bank of Finland rolled out a central bank 'e-money system' for retail payments. This e-money would be deployed via a stored-value card. It was a central bank token distributed by commercial banks.[4] During the 1990s and early 2000s, the idea that would become a CBDC ranged from legal tender e-cash to government-issued e-money.[5] Basically, these were forms of electronic currency that would act the same way as hard currency. The model was a banknote in digital format. As the 2010s arrived, ideas became refined. People began to talk about coins and tokens and Bitcoin.[6] Then, the Bank of England spoke about a 'CBDC,' meaning a government currency using blockchain and cryptographic technologies. By the late 2010s and early 2020s, there was no official definition of a CBDC. However, there was a general agreement that a CBDC had the following attributes: it is a central bank liability on par with cash and reserves, giving the CBDC user a claim on the central bank; it is digital, being based on a form of the electronic ledger; it is denominated in the national currency; and it is intended to be used to make payments and be a store of value.[7]

2 Bank of England, 'One Bank Research Agenda', February 2015, 6, https://www.bankofengland.co.uk/-/media/boe/files/research/one-bank-research-agenda---summary.pdf?la=en&hash=B2C820FBF6A960C4A625C2DAB5B5B6CE4FEDF120.

3 James Tobin, 'Financial Innovation and Deregulation in Perspective', *BoJ Monetary and Economic Studies*, September 1985, 22, 25.

4 Aleksi Grym, 'Lessons Learned from the World's First CBDC', BoF Economics Review (Helsinki: Bank of Finland, 2020), 2, 3, 5, 14-15, http://hdl.handle.net/10419/224448.

5 Joshua B Konvisser, 'Coins, Notes, and Bits: The Case for Legal Tender on the Internet', *Harvard Journal of Law & Technology* 10, no. 2 (Winter 1997): 32.

6 JP Koning, 'Moneyness: Why the Fed Is More Likely to Adopt Bitcoin Technology than Kill It Off', *Moneyness* (blog), 14 April 2013, https://jpkoning.blogspot.com/2013/04/why-fed-is-more-likely-to-adopt-bitcoin.html; Simon Scorer, 'Central Bank Digital Currency: DLT, or Not DLT? That Is the Question', Bank Underground, 5 June 2017, https://bankunderground.co.uk/2017/06/05/central-bank-digital-currency-dlt-or-not-dlt-that-is-the-question/.

7 Grym, 'Lessons Learned from the World's First CBDC', 11–12; 'Central Bank Digital Currency', Banque de France, 4 February 2020, 2, https://publications.banque-france.fr/en/central-bank-digital-currency.

1.2 The evolution of CBDCs

1.2.1 The e-money threat

As we have seen, the idea of a CBDC has been discussed for a while. Nevertheless, what first prompted the investigation into a digital currency issued by a central bank?

Suppose we start with Tobin's article in 1985. In that case, we see that the pursuit of central bank digital currencies arose out of a need to meet the potentially destabilising monetary forces of the new e-money.

From the 1980s to the early 2000s, electronic money was seen as a revolutionary phenomenon, threatening to upset the monetary world and make central banks obsolete.[8] E-money was developing so fast that its definition changed over time.

8 Grym, 'Lessons Learned from the World's First CBDC', 4.

At first, electronic money meant reloadable smartcards (electronic purses) and programs that used the internet to make payments (digital cash).[9] Later, e-money included products that allowed users or their agents to access their bank accounts to transfer money (credit and debit cards).[10]

9 Bank for international settlements, ed., *Implications for Central Banks of the Development of Electronic Money* (Basle [Paris]: Bank for international settlements [diff. Banque de France], 1996), 1.

10 Marco Arnone and Luca Bandiera, 'Monetary Policy, Monetary Areas, and Financial Development with Electronic Money', *IMF Working Papers* 04, no. 122 (2004): 4, https://doi.org/10.5089/9781451854527.001.

In 1985, Tobin saw the rise of computing power and electronic payments as threatening the dominance and efficiency of government money: 'Electronic payments networks are making possible instantaneous payments via computer from one account to another.' He saw the idea that private monies and 'free market principles' could supply an economy's money as a challenge to 'the exception which assigns government the responsibility to limit the supply of money.' Tobin believed that his 'deposit currency' would allow the central bank to 'still have effective monetary control in the new system.'[11]

11 Tobin, 'Financial Innovation and Deregulation in Perspective', 20,21,28.

At the same time, in Finland, the central bank thought that it was its responsibility to avoid inefficiencies in payments arising from 'a situation where multiple, incompatible systems would be competing in a fragmented market.'[12] It was feared (and not just at the Bank of Finland) that this new e-money would create a private issuers system that would issue their own electronic alternative to cash.[13] Also, the bank saw it as its mandate to provide an electronic equivalent to cash, although it need not be considered a legal tender.[14]

12 Grym, 'Lessons Learned from the World's First CBDC', 4.

13 Konvisser, 'Coins, Notes, and Bits: The Case for Legal Tender on the Internet', 334.

14 Grym, 'Lessons Learned from the World's First CBDC', 5.

During the 1990s and 2000s, the threat of e-money replacing central bank cash worried central banks the most. There were fears of monetary and financial chaos as private issuers competed to supplant cash as a payment vehicle.[15] The widespread acceptance of e-money as a substitute for physical money could also shrink a central bank's balance sheet, impacting open market operations and the ability of the bank to affect monetary policy.[16] There might also be a decline in central bank seigniorage because of the decline in asset holdings and interest earned on these assets.[17] The decline in seigniorage was especially troubling, and it was seen as part of a long-term decline that could threaten central banks' ability to fund themselves.[18]

15 Yuksel Gormez and Forrest Capie, *Surveys on Electronic Money*, Bank of Finland Discussion Papers 7/2000 (Helsinki: Bank of Finland, 2000), 7.

16 Arnone and Bandiera, 'Monetary Policy, Monetary Areas, and Financial Development with Electronic Money', 3.

17 Bank for international settlements, *Implications for Central Banks of the Development of Electronic Money*, 7; Johannes M Groeneveld and Ad Visser, 'Seigniorage, Electronic Money and Financial Independence of Central Banks', *Banca Nazionale Del Lavoro Quarterly Review*, n.d., 82–83; Bank for international settlements, 'Survey of Electronic Money Developments', 14 November 2001, https://www.bis.org/cpmi/publ/d48.htm.

18 Groeneveld and Visser, 'Seigniorage, Electronic Money and Financial Independence of Central Banks', 80–85; Konvisser, 'Coins, Notes, and Bits: The Case for Legal Tender on the Internet', 343.

The way for a central bank to counter these threats was for it to either impose reserve requirements on e-money issuers or for it to issue its own form of e-money held on its balance sheet.[19] After all, it was argued that if a central bank had a monopoly on cash, it was only logical for it to have one on its electronic alternative, e-money. This would allow for economies of scale, security in transactions, and the provision of an electronic legal tender.[20] By the middle of the 2000s, the idea of a CBDC was present and current. All that was lacking was the name.

19 Bank for international settlements, *Implications for Central Banks of the Development of Electronic Money*, 10; Groeneveld and Visser, 'Seigniorage, Electronic Money and Financial Independence of Central Banks', 86; Arnone and Bandiera, 'Monetary Policy, Monetary Areas, and Financial Development with Electronic Money', 9, 14–15.

20 Groeneveld and Visser, 'Seigniorage, Electronic Money and Financial Independence of Central Banks', 86; Konvisser, 'Coins, Notes, and Bits: The Case for Legal Tender on the Internet', 321–52.

1.2.2 The cryptocurrency threat

Over the next decade, the threat of the e-money revolution faded, and the idea of a CBDC largely slept. Moreover, by the middle of the 2010s, the need for a central bank to issue its own e-money was being dismissed.[21] Nevertheless, during this time, a new phenomenon arose — cryptocurrency.

21 Ben Fung, Miguel Molico, and Gerald Stuber, 'Electronic Money and Payments: Recent Developments and Issues', *Bank of Canada Discussion Paper*, no. 2 (April 2014), https://doi.org/10.34989/SDP-2014-2.

Bitcoin, launched in January 2009, was largely unknown outside its own community. However, by the 2010s, some commentators in central bank circles were referring to 'digital currency.' One Bank of England blogger said:

> Digital currency is no longer the preserve of cypherpunks and crypto-anarchists.[22]

22 Marylin Tolle, 'Central Bank Digital Currency: The End of Monetary Policy as We Know It?', *Bank Underground* (blog), 25 July 2016, https://bankunderground.co.uk/2016/07/25/central-bank-digital-currency-the-end-of-monetary-policy-as-we-know-it/.

Private digital currencies were the potential new threat to central bank operations.[23]

23 CPMI, 'Digital Currencies', BIS Report (Basel: Bank for International Settlements, 2015), 3, https://www.bis.org/cpmi/publ/d137.pdf.

In 2009, Facebook announced a new digital currency called Facebook Credits, which some foresaw becoming a global currency.

This and the growth of PayPal prompted new central bank investigations into creating their own 'digitisation of state-issued currencies.'[24] Then, in a 2013 blog, JP Koning applied the Bitcoin model to United States payments, primarily Fedwire, arguing that the Fed should adopt distributed ledger technology.[25] From here, it was a short jump to the idea of a *Fedcoin*, which would be a cryptocurrency issued by the Fed and be convertible at a rate of 1:1 with the Fed's physical currency and its electronic reserves.[26] The idea was already in the air as Sina Motamedi had contemporaneously raised the idea of a *BitDollar* along the same lines as Koning.[27]

24 Joshua S Gans and Hanna Halaburda, 'Some Economics of Private Digital Currency', in *Economic Analysis of the Digital Economy*, ed. Avi Goldfarb, Shane M Greenstein, and Catherine E Tucker (University of Chicago Press, 2015), 257, 260–61, https://doi.org/10.7208/9780226206981-012; M Shoaib, M Ilyas, and M S Hayat Khiyal, 'Official Digital Currency', in *Eighth International Conference on Digital Information Management (ICDIM 2013)*, 2013, 346–52, https://doi.org/10.1109/ICDIM.2013.6693982.

25 Koning, 'Moneyness', 14 April 2013.

26 JP Koning, 'Moneyness: Fedcoin', *Moneyness* (blog), 19 October 2014, https://jpkoning.blogspot.com/2014/10/fedcoin.html. Koning fully developed his ideas in JP Koning, 'Fedcoin: A Central Bank- Issued Cryptocurrency', R3 Reports, 15 November 2016, https://www.r3.com/wp-content/uploads/2017/06/fedcoin_central-bank_R3.pdf.

27 Sina Montemedi, 'Will Bitcoins Ever Become Money? A Path to Decentralized Central Banking', *Tannu Tuva Initiative* (blog), 21 July 2014, https://tannutuva.org/2014/will-bitcoins-ever-become-money-a-path-to-decentralized-central-banking/.

Indeed, as 2014 became 2015, the Bank of England recognised that the new digital currencies were raising 'fundamental questions for financial regulation, money demand generally and central bank money in particular.' For example, might central banks issue digital currencies...?'[28] The agenda was now set to study the future of a CBDC. Moreover, there were studies of 'government cryptocurrency' and 'centrally banked cryptocurrencies' involving the search for 'a scalable cryptocurrency' whose supply and deployment could be controlled by a central bank.[29] Such a move would meet 'the threat of Bitcoin' to a central bank's control over monetary policy, financial stability, and other elements of its sovereignty in such matters.[30]

28 This is considered the first use of the term 'central bank digital currency': Bank of England, 'One Bank Research Agenda', 6.

29 George Danezis and Sarah Meiklejohn, 'Centrally Banked Cryptocurrencies', 2015, 2, https://doi.org/10.48550/ARXIV.1505.06895; David Andolfatto, 'MacroMania: Fedcoin: On the Desirability of a Government Cryptocurrency', *MacroMania* (blog), 3 February 2015, https://andolfatto.blogspot.com/2015/02/fedcoin-on-desirability-of-government.html.

30 David Andolfatto, 'MacroMania: Bitcoin and Central Banking', *MacroMania* (blog), 12 November 2015, https://andolfatto.blogspot.com/2015/11/bitcoin-and-central-banking.html.

1.2.3 The cooptation of cryptocurrency technology

The new concept of a CBDC was now applied to the old fears first raised by the rise of e-money in the 1990s. Central banks explored how a CBDC could help meet the replacement of cash by private digital currencies, how it could help a central bank maintain sufficient seigniorage to continue operating, and how it could enable a central bank to execute monetary policy effectively in this new digital age.[31] So, some central banks began experimenting with digital currencies to execute interbank settlements.[32] Furthermore, in 2017, Sweden launched the e-krona project to offset the country's declining cash use, which threatened to hand the payment market to private payment services.[33]

31 For example, see European Central Bank, 'More than an intellectual game: exploring the monetary policy and financial stability implications of central bank digital currencies', 8 April 2022, https://www.ecb.europa.eu/press/key/date/2022/html/ecb.sp220408~980e39957b.nl.html; Michael Bordo and Andrew Levin, 'Central Bank Digital Currency and the Future of Monetary Policy' (Cambridge, MA: National Bureau of Economic Research, August 2017), https://doi.org/10.3386/w23711; Walter Engert and Ben S C Fung, 'Central Bank Digital Currency: Motivations and Implications', 2017, https://doi.org/10.34989/SDP-2017-16.

32 See, for example, Rod Garratt, 'CAD-Coin versus Fedcoin', R3 Reports, 15 November 2016, https://www.r3.com/wp-content/uploads/2017/06/cadcoin-versus-fedcoin_R3.pdf; Monetary Authority of Singapore, 'MAS, R3 and Financial Institutions Experimenting with Blockchain Technology', 16 November 2016, https://www.mas.gov.sg/news/media-releases/2016/mas-experimenting-with-blockchain-technology.

33 Sveriges Riksbank, 'The Riksbank's e-Krona Project', September 2017, 39.

However, by this time, countries were seeing what else CBDCs might do. One idea was financial inclusion. A CBDC could allow everyone to have an account directly with the central bank. No one would be left unbanked.[34] Such accounts would also allow for speedy, paperless government payments. Further, smaller countries, such as the Bahamas, Ecuador, Senegal, and Uruguay, believed that a CBDC would be a low-cost means of payment as compared with cash, saving the central bank money and extending access to central bank money to a wider segment of the population.[35] These ideas and others, like the remuneration of CBDCs (including negative interest rates to break the zero lower bound) and their uses in maintaining price stability, dealing with criminal activities, and providing helicopter money, were also being explored in 2018.[36]

34 Aleksander Berentsen and Fabian Schar, 'The Case for Central Bank Electronic Money and the Non-Case for Central Bank Cryptocurrencies', *Review* 100, no. 2 (2018): 101–2, https://doi.org/10.20955/r.2018.97-106.

35 Tommaso Mancini-Griffoli et al., 'Casting Light on Central Bank Digital Currencies', IMF Staff Discussion Note, 18, no. 08 (November 2018): 16, 27–28, https://www.imf.org/-/media/Files/Publications/SDN/2018/SDN1808.ashx.

36 For example, see Nuño Barrau, 'Monetary Policy Implications of Central Bank-Issued Digital Currency'; Berentsen and Schar, 'The Case for Central Bank Electronic Money and the Non-Case for Central Bank Cryptocurrencies'; JP Koning, 'Approaches to a Central Bank Digital Currency in Brazil', R3 Reports, 15 October 2018, https://www.r3.com/wp-content/uploads/2018/11/CBDC_Brazil_R3.pdf.

Discussions about the technical aspects of central bank digital currencies also became more sophisticated. Debates coalesced around two points: how to distribute CBDCs and what form they would take. The two basic ways to distribute a CBDC were laid out by Tobin in 1985.[37] By 2017, these had various labels but are currently referred to as the retail and wholesale methods. The retail approach—sometimes referred to as the 'general' or the 'direct' approach[38]—argued that a CBDC would be best distributed by having all users hold accounts with the central bank. Users would then have direct access to the digital currency. The wholesale or 'indirect' approach was more decentralised. A central bank would issue its CBDC to banks, distributing it, like cash, via accounts held by individuals and businesses.[39] (In some cases, a wholesale CBDC was to be limited to use in interbank settlements.)[40]

37 Tobin, 'Financial Innovation and Deregulation in Perspective', 25–26.

38 Codruta Boar, Henry Holden, and Amber Wadsworth, 'Impending Arrival – a Sequel to the Survey on Central Bank Digital Currency', *BIS Papers* 107 (January 2020): 1–5, https://www.bis.org/publ/bppdf/bispap107.pdf.

39 For example, see Ben Dyson and Graham Hodgson, 'Why Central Banks Should Start Issuing Electronic Money', Positive Money, January 2016, 15–19; Engert and Fung, 'Central Bank Digital Currency', 1; Michael Kumhof and Clare Noone, 'Central Bank Digital Currencies – Design Principles and Balance Sheet Implications', *Bank of England*, Staff Working Paper, no. 7 (May 2018): 18–29, https://doi.org/10.2139/ssrn.3180713.

40 Morten Bech and Rodney Garratt, 'Central Bank Cryptocurrencies', BIS Quarterly Review, September 2017, 66–67.

The discussion about what form a CBDC would take involved systems based on accounts or tokens and how payments would be settled. An account-based CBDC would execute payments by transferring claims between accounts in a centralised system. Meanwhile, in a token-based system, a digital token would be transferred through a more decentralised arrangement. Researchers debated which system was best given the inherent counterparty risks, varying degrees of access by the public, and differing losses of anonymity in transactions in each approach. On the latter point, it was noted that in an account-based system, the account holder had to be identified.

Nevertheless, only the token's authenticity had to be identified in a token-based system.[41]

41 Mancini-Griffoli et al., *Casting Light on Central Bank Digital Currencies*, 4; Charles Kahn, Francisco Rivadeneyra, and Tsz-Nga Wong, 'Should the Central Bank Issue E-Money?', Federal Reserve Bank of St. Louis Working Paper, no. 2019–003 (2019): 8–11, https://doi.org/10.20955/wp.2019.003.

The years 2018 and 2019 saw the accelerated expansion of CBDC studies. While in 2014, there were approximately six published studies relating to central bank digital currencies and one pilot project underway, in 2019, around 45 studies were released, and 16 new pilots were undertaken. The accelerant was the recent cryptocurrency boom.

By the middle of 2019, the monetary world had passed through the ICO boom, seen Bitcoin run through two great bull markets, and heard the announcement by Facebook of a new global stablecoin known as Libra.

As investigations into central bank digital currencies jumped into high gear in 2020 and 2021, ideas arose about hybrid and programmable CBDCs. A hybrid CBDC distribution model is a rough combination of the retail or direct and wholesale or indirect models. Under the retail model, consumers perform transactions with the central bank's digital currency. Moreover, under the wholesale model, banks manage the use of the CBDC. However, in the hybrid model, users do not have an account with the central bank or direct access to the CBDC. Neither do the banks generate their own form of CBDC (being their liability) for distribution. Instead, banks act as a passthrough for the central bank's digital currency, acting as distribution channels for the central bank's liability.[42]

42 Raphael Auer and Rainer Boehme, 'The Technology of Retail Central Bank Digital Currency', *BIS Quarterly Review*, March 2020, 88–91. The hybrid model was also known as a two-tiered CBDC, Centre for the Fourth Industrial Revolution,