

Central bank digital currencies: policy and design

The evolution of money in an increasingly digitalised world



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Key points

- Central bank digital currencies (CBDC) are designed to allow direct access to a central bank's deposits also to households
- Currently, a vast majority of central banks are engaging in CBDC research
- CBDC is neither a cryptocurrency nor a totally new technology, but rather a natural evolution of money in order to cope with rapid technological progress
- Design features must be carefully assessed, as to not to interfere with existing monetary goals
- However, CBDC's costs and benefits are not limited to the monetary sphere, as they extend into the social and environmental realm
- Monetary policy and financial stability are key points on the CBDC research agenda
- Several solutions to financial stability risks have been proposed, particularly solutions based on the concept of quantity rationing or interest rate tiering of CBDC
- Broader macroeconomic and strategic geopolitical effects (e.g. 'first-mover advantage') of CBDC must be accounted for
- The future co-evolution of traditional and digital currencies is still an open question

"The essential superiority of a monetary economy over a barter economy is the saving of mental effort made possible by money...this service can be rendered by money only if there is a sufficient stability in its purchasing power"
(Lerner, 1952)

This paper discusses the potential benefits and the challenges of central bank digital currencies (CBDC), i.e. collateralised digital currencies issued by a monetary authority. Starting with a brief review of money, we then analyse both the similarities and differences between digital and traditional currencies. We also consider the advantages of a CBDC over a private sector digital currency. While providing a summary of existing relevant research, we highlight the importance of digital currencies for future research in other areas of economics.

CBDC is not a cryptocurrency

This insight is not about investing in cryptocurrencies such as bitcoin, which are a world away from CBDC. We have discussed bitcoin and cryptocurrencies in detail in a [previous research note](#). European Central Bank (ECB) executive board member Fabio Panetta has been rather outspoken in addressing the difference between the two. He asserted: *"CBDCs have nothing to do with crypto-assets such a Bitcoin...a CBDC would be a liability of the central bank and would be backed by its assets. It would be supported by the credibility of the central banks and, ultimately, by law. Crypto-assets, on the other hand, are a liability belonging to nobody: there is no*

asset that backs them up and no clear governance structure.”¹

After a relatively short period of scepticism, central bankers are now collectively studying and experimenting with digital currencies. Recently, the Bank for International Settlements entered the game in its usual role of coordinator². According to Auer et al. (2020), roughly 80% of the surveyed central banks are currently engaging in CBDC research, experimentation and development. Moreover, 20% of the world’s central banks are planning to launch a retail CBDC in the medium term. Additionally, the ECB has recently released a comprehensive report on a digital euro³ and is expecting to launch a CBDC project by the middle of 2021.

Part of the sudden surge in central banks’ interest in digital currencies is a result of the rapid pace of financial innovation from the world’s technology giants (aka “Big Tech”) and the incumbent threat of a universal digital currency operator, like for example the Libra Association (later renamed the Diem Association) – a Facebook-created consortium to help its proposed cryptocurrency. While this innovation implies – at least in theory – the political choice between a publicly and a privately-managed digital currency, in reality “central banks have a strong interest to maintain control over the payment system as well as the financial sector more broadly and to defend the attractiveness of their home currency. *Nolens volens, they will therefore introduce reserves for all.*”⁴

From a social perspective, digital currencies are efficient instruments in delivering financial inclusion and information sharing, even though there is a need for regulation to prevent unlawful access to private information and illegal transactions.

The introduction of digital currencies could pose a serious threat to financial stability and monetary authorities are diligently studying potential threats risks to the banking sector⁵. These risks apply to publicly and privately-issued digital currencies. While research is advancing at a rapid pace, implementation is still in its infancy and financial regulators and investors will eventually have to come to terms with this new instrument.

The function of money: A brief review

To begin our discussion, we recall the functions of money:

1. Medium of exchange/payment
2. Measure of value: Prices are expressed in predefined units (e.g. dollars)

¹ Panetta (2018)

² BIS (2020)

³ ECB (2020)

⁴ Niepelt (2019)

3. Store of value: Money needs to retain its value in time, otherwise firms and households will search for better alternatives

Ideally, money is a fungible, durable, portable and identifiable medium with a stable value. To put it bluntly: “*Money is the most universal and most efficient system of mutual trust ever devised ...even people who do not believe in the same god or obey the same king are more than willing to use the same money.*”⁶

Another characteristic of money, equally important and innovative in our view, is related to information: “*We assume that money is also a store of information. As currency is a disseminator of information, individuals consider the privacy (transparency) risks inherent in using a given currency for trading, given that any exchange can disseminate information on the exchangers. In other words, we assume the existence of expected privacy costs – or anonymity costs – when using money for exchanges. These privacy costs can be associated with the value of each transaction and with the number of transactions.*”⁷

Furthermore, the ambition of financial inclusion has been widely discussed at supranational level. For example, the World Bank Group has identified a disconnect between the penetration of mobile technology in rural areas and the regional distribution and availability of banking accounts. Given the high percentage of financially-excluded adults (Exhibit 1), inclusion can be fostered with the aid of Distributed Ledger Technology (DLT) across several dimensions:

- Economic identity
- Remittance services
- Services for refugees and migrants
- Digital identity for citizens in poverty

Exhibit 1: 1.7bn adults do not have a bank account



Source: World Bank (Data: Adults without an account as of 2017)

We acknowledge that a digital currency does not strictly need blockchain as a pre-requisite. However, some areas of inclusion are nonetheless common to both technologies, for

⁵ Bindseil (2020)

⁶ Harari (2015)

⁷ Masciandaro (2018)

example universal income programmes or the direct and personal disbursement of public aid to arriving refugees.

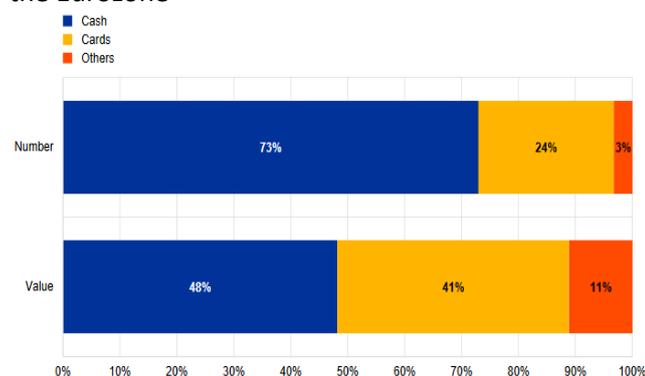
Is there a role for cash in a digital world?

While we all appreciate the past and future benefits of money, we're still left with the question – why do we need money at all? While not without possible major difficulties (the so called “double coincidence of wants” problem), people could as well trade their goods and services in a direct barter economy. On the other hand, cash still appears to be the most favoured means of payment in developed societies.

Data-based evidence

Recent research⁸ suggests that despite the rapid spread of digitalisation, the use of physical cash has increased around the world during the past decade. Moreover, Ashworth and Goodhart (2020) point out that COVID-19-related precautionary saving might have exacerbated this trend, while others⁹ highlight monetary policy and demographics – elderly people have a preference for physical cash versus digital means of payment – as the main factors behind cash hoarding.

Exhibit 2: Cash is still a popular payment technology in the Eurozone



Source: ECB, March 2021

However, there also appears to be an underlying trend in consumers' preferred means of payment as pointed out by a study released by the ECB (2020):

- Cash is still the predominant point of sale and person-to-person instrument, but the share of cash usage in daily transactions has dropped to 73% from 79% three years ago (Exhibit 2)
- The pandemic has accelerated this trend with respondents saying they used less cash in 2020 and are also planning to continue to pay less with cash in the future

On the other hand, both Sweden and Norway stand out and are often cited as a paradigm for a cashless society. However,

a sequence of mutually-reinforcing events and policy changes appears to have had a special effect on the demand for cash by Swedish citizens¹⁰. These include the introduction of measures aimed at reducing tax evasion starting in 2007, notes and coins changeover by the Riksbank between 2012 and 2017 and the introduction of mobile payment system Swish in 2012. In addition, there has been a significant reduction in official cash distribution centres and the strong trust in the government's ability to protect retail deposits at times of crisis. From this point of view, the so-called 'cashless society' looks more like the result of a partially intentional policy decision as opposed to a trendy habit.

Of course, the benefits of using cash don't come for free. For example, the costs associated with operating a retail payment network in the European Union (EU) are surprisingly high. As stated in the ECB paper *the social and private costs of retail payment instruments: a European perspective*: “On average, they amount to almost 1% of GDP for the sample of participating EU countries. Half of the social costs are incurred by banks and infrastructures, while the other half of all costs are incurred by retailers. The social costs of cash payments represent nearly half of the total social costs, while cash payments have on average the lowest costs per transaction, followed closely by debit card payments.”¹¹.

Theoretical background

From a purely theoretical perspective, exploring the micro-foundations of money is as central to the New Monetarist research agenda as to our understanding of digital currencies. New Monetarists consider search theory as a valuable tool for modelling the nitty-gritty of monetary exchange. One obvious result is that the standard search/matching model (the bread and butter of new monetarists) also embed a set of conditions for markets to be 'frictionless', as discussed by Kocherlakota (1996):

- Traders have memory
- Trading history is publicly available
- Trade transgression is enforced and punished

The need for decentralised, pair-wise trading (i.e. for money) results from any departure of the above set of conditions: “Money is essential when it overcomes the double coincidence of wants problem combined with limited commitment and imperfect record keeping.”¹²

Stablecoins: The evolution of digital currencies

Now that we've reviewed the function, the purpose and the utilisation of money, we turn our attention to digital currencies. In our view, any tentative definition would sound misleading

⁸ Armelius et al. (2020)

⁹ Shirai / Sugandi (2019)

¹⁰ Armelius et al. (2020)

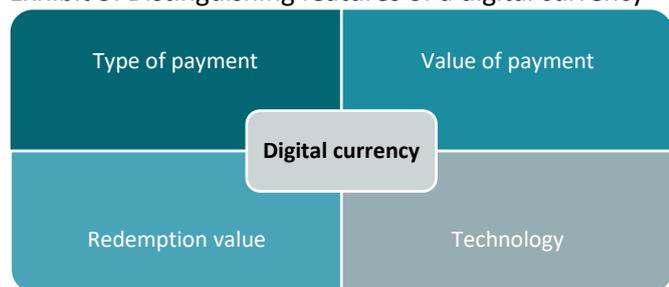
¹¹ Schmiedel et al. (2012)

¹² Williamson/Wright (2010)

without duly addressing the complexity of the subject. Adrian/Mancini-Griffoli (2019) use a ‘money tree’ to better single out a digital means of payment relative to cash (Exhibit 3):

- Type of payment: Claim vs. object
- Value of payment: Fixed vs. variable redemption value (for claims) and denomination (for objects)
- Redemption guarantee (for claims only): Private vs. government backstop
- Technology: Centralised vs. decentralised settlement

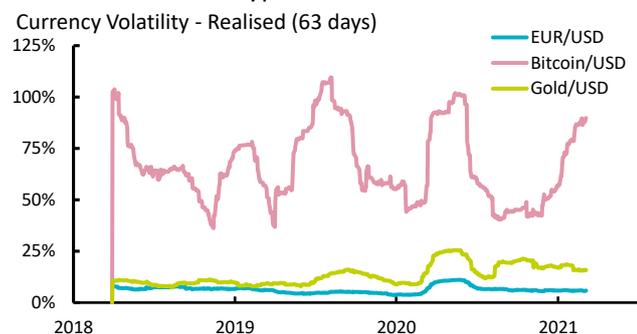
Exhibit 3: Distinguishing features of a digital currency



Source: AXA IM Research

The backstop – a digital currency’s collateral framework – is key in order to distinguish so called stablecoins from the broader ecology of digital currencies. It is an essential design feature, one likely to influence the path of adoption¹³ of any nascent digital currency. The idea is to limit excessive price swings typical of crypto assets (Exhibit 4) in order to align the new currency with existing, traditional currencies. As former ECB Executive Board member, Benoît Cœuré, stated *“Originally envisioned as an accessible and borderless way to pay, crypto-assets have generally suffered from severe price volatility and limited capacity to process transactions compared with existing arrangements...The developers of the crypto-assets labelled ‘stablecoins’ seek to reduce volatility by anchoring the ‘coin’ to a reference asset (e.g. a sovereign currency) or a basket of assets.”*¹⁴

Exhibit 4: Volatile crypto assets



Source: Bloomberg and AXA IM Research, 5 March 2021

¹³ There is extensive literature on technological dynamics, which readily applies to digital currencies and their path to adoption. The interested reader might want to start with Arthur (1989).

¹⁴ Cœuré (2019)

¹⁵ Bordo/Levin (2017)

¹⁶ Barrdear/Kumhof (2016)

The role of central banks: CBDC design

We now consider a specific type of digital currency, i.e. one provided by the central bank. Following is a list of possible definitions from academics as well as central bankers:

- “CBDC would be fixed in nominal terms, universally accessible, and valid as a legal tender for all public and private transactions. Consequently, CBDC is essentially different from the various forms of virtual currency...that have been created by private entities and whose market prices have exhibited very sharp fluctuations”¹⁵
- “By CBDC, we refer to a central bank granting universal, electronic, 24x7, national-currency-denominated and interest-bearing access to its balance sheet”¹⁶
- “Cash’s digital counterpart is currently being debated under the heading of ‘central bank digital currency’...Unlike cash, CBDC would likely not be anonymous, although it could protect users’ data from third parties. Its validation technology could be centralized or decentralized, and it could offer interest.”¹⁷
- “In addition to banknotes and other liabilities, central banks issue digital money – reserves – but only to a select group of financial institutions...The innovative part of CBDC is not its digital nature, but broad access.”¹⁸
- “A CBDC will allow the central bank to engage in large-scale intermediation by competing with private financial intermediaries for deposits...In other words, a CBDC amounts to giving consumers the possibility of holding a bank account with the central bank directly.”¹⁹

Therefore, the key difference between CBDC and central bank reserves is the digital currency’s population-wide availability, rather than to monetary and financial institutions alone – as is the case, for example, in the Eurosystem. As the ECB’s Executive Board member Fabio Panetta said: *“What we do not have is a digital currency that is issued by the central bank and that we can all use in daily life. In other words, we do not have a digital equivalent of euro banknotes.”*²⁰

Legal aspects

Strictly speaking, a central bank would only issue a CBDC once all citizens are provided with the necessary tools to access and use it. The definition of legal tender status presumes that any payment technology (e.g. coins and banknotes) can be used to pay existing obligations by a simple transfer between debtors and creditors. This point has been raised recently by an International Monetary Fund staff paper²¹ that analyses the legal framework of 174 central

¹⁷ Adrian/Mancini-Griffoli (2019)

¹⁸ Niepelt (2020)

¹⁹ Fernandez-Villaverde et al. (2020)

²⁰ Panetta (2020)

²¹ Bossu et al. (2020)

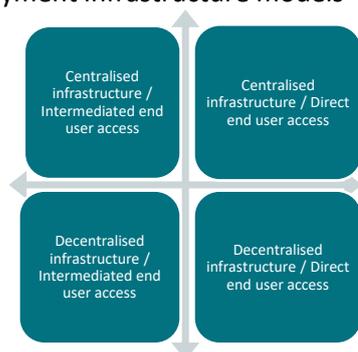
banks around the world. The conclusion is somewhat perplexing, as currently only 40 central banks have the legal status to issue a digital currency. Therefore, central banks and their owners will need to provide an appropriate legal basis before launching a CBDC.

The CBDC architecture

The CBDC-infrastructure model is a key area of research. The commonly accepted doctrine distinguishes between four alternative models. Exhibit 5 is just an expansion of the CBDC architectural characterisation recently proposed by Auer/Böhme (2020). In our view, the main distinction is between a direct and an indirect architecture:

- Direct architecture: The central bank operates the retail ledger and is involved in all payments
- Indirect architecture: The central bank issues the CBDC, while not accepting a direct relationship with end users. A counterparty dealing with retail payments needs to be plugged in

Exhibit 5: Payment infrastructure models



Source: ECB and AXA IM Research

While a direct model provides the end user with a very resilient framework – almost in the spirit of cash – an intermediated model allows for decentralised risk sharing as well as the involvement of emerging FinTech services. On balance, there seems to be a trade-off between regulatory needs and technological resilience – as previously posited – “(central banks) can operate either complex technical infrastructures or complex supervisory regimes”²².

In our view, the role of the private sector within the payment framework should be emphasised, as the introduction of a CBDC might be disruptive for the retail banking business.

And again, is this an entirely novel topic? In a sense, a CBDC might bring us back to a monetary model of the past, when central banks were involved in commercial business (e.g. provision of demand deposits, credit creation and payment system integration etc.). This was the case, for example, in

the early days of the Bank of England and the Bank of Spain. Of course, today’s advanced level of digitalisation allows a central bank to better integrate or compete with private commercial banks. Central banks running a large country-wide network of branches are a model of the past.

Pros and cons of a CBDC

Before analysing the benefits and the costs of a CBDC, it is worth noting that reserve-like forms of money have been around for quite some time. Furthermore, they are typically superior to cash, as brilliantly exposed by Nobel laureate James Tobin (1985): “Paper currency and coin are not very convenient media of exchange, except for small items of consumption, vending machines, and certain transactions among total strangers. Where they are useful in large payments, it is for discreditable reasons, tax avoidance or crime. Currency is too bulky for large legitimate transactions, awkward because it comes only in few denominations, vulnerable to loss or theft, unsuitable for remittance by mail.”

CBDC objectives and design characteristics

Let’s now turn our attention to the objectives of issuing a CBDC. It should be noted that an optimal currency design is likely to address the following universal criteria:

- Universal access to central bank money, especially in those countries where the use of cash is declining. This objective is often associated with strengthening the monetary transmission channel²³
- Increased competition in the payment industry, thus benefitting from efficiency gains and reduced intermediation costs. However, it must be added that competition in this sector is already high, thanks to several private providers of digital payments. The added value of a CBDC to the payment system must therefore be measured in terms of social value e.g. financial inclusion of unbanked households
- Improved financial stability, mainly by reducing the risk of bank runs. However, this may come at a cost to the retail operations of commercial banks and is currently one of the main sub-fields of research related to CBDC
- Maintaining control of the monetary system, i.e. deploying “a powerful lever with which to assert our sovereignty in the face of private-sector initiatives such as Libra”²⁴
- Compliance with the regulatory framework
- Cyber resilience

Furthermore, the ECB²⁵ has released a complete set of scenario-specific requirements for a CBDC to be viable in a modern monetary system (Exhibit 6).

²² Auer/Böhme (2020)

²³ Niepelt (2020)

²⁴ Villeroy de Galhau (2019)

²⁵ ECB (2020)

Exhibit 6: Scenario-specific digital euro characteristics

Digital efficiency	<ul style="list-style-type: none"> State-of-the-art technology Interoperable with private payment solutions
Cash-like	<ul style="list-style-type: none"> Offline payments Free of charge for basic use
Competitive	<ul style="list-style-type: none"> At the technological frontier Attractive vs. other currencies
Monetary policy option	<ul style="list-style-type: none"> Remuneration at a variable interest rate
Back-up system	<ul style="list-style-type: none"> Overall financial system resilience Separate payments channel
International use	<ul style="list-style-type: none"> Universal acceptance Trade policy
Cost saving	<ul style="list-style-type: none"> Lower the cost of the current payment ecosystem
Environmental	<ul style="list-style-type: none"> Minimise ecological footprint

Source: ECB and AXA IM Research, March 2021

Note these come in addition to more obvious ‘core principles’ like convertibility at par, universality, liability of the Eurosystem, market neutrality (i.e. no crowding out of private solutions) and end-users’ trust. As these already apply to the existing currency technology, we won’t elaborate further.

Research agenda for the future

Monetary policy

The controversy around the effectiveness of traditional monetary policy at negative interest rates has been on for a while²⁶. Some scholars have proposed to eliminate physical money altogether, in order to avoid competition between retail bank accounts and cash when interest rates are below zero: *“It is precisely the existence of paper currency that makes it difficult for central banks to take policy interest rates much below zero ... if all central bank liabilities were electronic, paying a negative interest on reserves (basically a charging fee) would be trivial”*²⁷.

However, other forms of store of value in competition with negative interest bank deposits might be identified by the general public, for example real assets (e.g. gold) or tax prepayments. Also, foreign currency deposits have been mentioned in this context, but unfortunately the world has drifted toward a ‘new normal’ where negative interest rates are a common feature of developed economies (Exhibit 7). And as the monetary universe drifts toward this new normal, the central bank’s balance sheet becomes a pivotal instrument in the transmission of policy signals. In this spirit, the fundamental question about the future of monetary policy is raised by Panetta (2018): *“If central banks decided to make an asset – the CBDC – free of credit and liquidity risk, possibly remunerated, and available to anybody at no cost, their role in the economy would fundamentally change. The size of their balance sheets would likely increase, and with it their footprint in the economy. If the CBDC were account-based, central banks would start to interact directly with the private non-financial sector. Are*

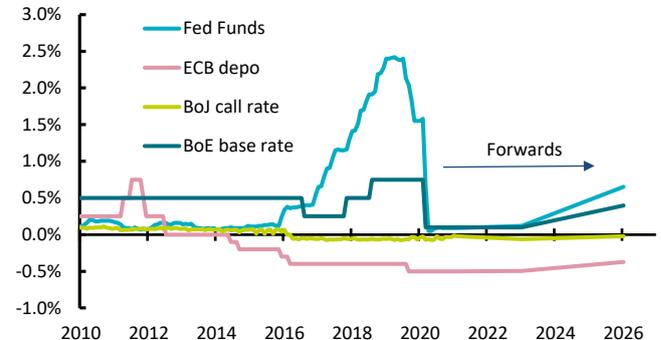
²⁶ See for example Brunnermeier/Koby (2018)

²⁷ Rogoff (2014)

central banks ready to play this new role and to deal with the attendant complexities? In the short term my answer is no.”

Exhibit 7: No imminent increase in interest rates

Global policy rates



Source: Bloomberg and AXA IM Research, 10 March 2021

Macroprudential policy

The complex relationship between CBDC, price and financial stability is a critical point in the design and the issuance of a digital currency. By issuing a CBDC, we might think of a central bank expanding its list of core competences with the addition of maturity transformation as well as private sector liquidity-shock buffering. By doing so, monetary policy adds a third component to the classic banking dilemma between a social optimum and bank runs – price stability. Schilling et al. (2020) demonstrate that a central bank (in contrast to the private banks sector, which cannot control the price level in the economy) can always implement an optimal allocation without bank runs by simply threatening high inflation. However, as price stability is a central bank’s key objective, it will necessarily face a trilemma: *“A central bank that wishes to simultaneously achieve a socially efficient solution, price stability and financial stability (i.e. absence of runs) will see its desires frustrated.”*²⁸

Reshaping the banking sector

Above, we have briefly addressed the relationship between CBDC and financial stability in the context of monetary policy objectives. The effect of CBDC on the banking sector itself merits deeper analysis. Not by chance, this is the single most debated CBDC-related issue both at academic and policy level. By entering the retail deposit arena, a central bank would likely face fierce competition from private commercial banks. The case in which a CBDC is simply a substitute for cash in circulation is not controversial (Exhibit 8). On the other hand, the case in which a CBDC becomes a substitute for retail deposits might affect the cost of funding for the banking sector and is therefore the less trivial case from a policy perspective²⁹. In this sense, a CBDC could become a truly disruptive instrument on a central bank’s balance sheet.

²⁸ Schilling et al. (2020)

²⁹ See Bindseil (2020) for further details.

Exhibit 8: CBDC substitutes cash in circulation

Private non-banks	
Banknotes	-1
CBDC	+1
Central bank	
Banknotes issued	-1
CBDC issued	+1

Source: CBDC and AXA IM Research, 16 March 2021

If needed, the government could always isolate the central bank from this competition using fiscal policy, however such a distortion might have far reaching consequences in terms of allocation of resources. Research in this area is still in its early stages. However, using a standard monetary model, Fernandez-Villaverde et al. (2020), formulate an equivalence theorem showing that “the set of allocations achieved with private financial intermediation will also be achieved with a CBDC, provided competition with commercial banks is allowed and depositors do not panic”. Unfortunately, additional analysis also suggests that the central bank might become a monopolist on the cash deposit market as households internalise the CBDC’s superiority in terms of store of value. The consequences are twofold; first commercial banks might suffer a substantial reduction in their retail funding (negative for credit ratings and stress tests etc.) and second by definition, the monopolist will have a limited incentive to deliver an optimal maturity transformation to the private economy.

CBDC tiering: A solution?

One way to avoid the likely negative effects on banks’ cost of funding, while at the same time retaining the advantages of issuing a CBDC, is rationing. For example, the operating central bank could limit the nominal amount of CBDC available to each citizen (quantity rationing). Alternatively, the central bank could introduce a dual remuneration rate to reduce the attractiveness of CBDC as a store of value (price rationing). According to Bindseil/Panetta (2020), tiered-CBDC remuneration would simultaneously achieve several objectives related to digital currencies. More importantly, it might preserve a central bank’s ability to successfully conduct negative interest rate policy without running the risk of a cyclical bank disintermediation. Unfortunately, a bank run is unlikely to be prevented by the asset’s negative remuneration rate³⁰. Therefore, our view is that more research on the relationship between CBDC and bank deposits is needed to optimise the introduction of this new technology. The liquidity-shock scenario is particularly relevant.

³⁰ In equilibrium, a rational agent is indifferent between owning the risky and the riskless asset, if the PV is identical. This implies a relationship between the remuneration rate of the riskless asset and the recovery rate of the risky asset. In practice, double-digit negative interest rates (price rationing) might be harder to implement than quantity rationing.

International policy

In addition to retaining monetary sovereignty against private operators (e.g. Diem), recent research has highlighted the issue of retaining sovereignty against other central banks in what is becoming a CBDC race. For some central banks – such as the People’s Bank of China – time itself appears to be an existential asset in this race, as is the case in a sequential game. In fact, Ferrari et al. (2020) model the introduction of a CBDC in an international interest-parity environment, which enables them to derive the existence of a first-mover advantage: “That a CBDC increases asymmetries in the international monetary system by reducing monetary policy autonomy in foreign economies, but not domestically, suggests in addition that introducing a CBDC sooner, rather than later, could give rise to a significant first-mover advantage.” Furthermore, the complexity of introducing and operating a CBDC increases in emerging economies³¹, where social, operational and regulatory aspects compound on top of an inherently more volatile macro environment.

Social policy

There are two ‘social’ elements to CBDC in our opinion. One is the possibility of tiering, i.e. a socially acceptable way to apply negative interest rates to non-banks. As mentioned above, the tiering argument has been formalised in the broader CBDC discussion by Bindseil (2020). We could even go a step further and propose the hypothesis that non-banks become subject to tiering based on their declared income. From a monetary perspective, the advantage is a less binding zero lower bound. The other social element is linked to the implementation of fiscal measures like the universal income and helicopter money. Blanchard/Pisani-Ferry (2019) define this latter strategy as “a fiscal expansion, in the form of higher transfers by the government to the people, financed by government bonds, which the central bank purchases in exchange for money through an open market operation”. Why not a green helicopter drop, then? And why not through a CBDC? After all, every individual would have an account at the central bank once a CBDC is introduced. In a recent Forbes article, the author suggests that in the US it costs on average “4.1% of the amount to cash a payroll check through cash checking services”³², thus highlighting the cost efficiency of digital currencies.

Environmental policy

A green CBDC would establish a strong direct link between green finance and the central banks’ balance sheet. Therefore, if the call is for monetary policy to turn green³³, then a green CBDC might be a good starting point. Of course, fiscal and macroprudential policies would have to follow in

³¹ Feyen et al. (2020) provide a thorough summary of CBDC in emerging markets

³² Huang (2020)

³³ Lagarde (2021)

the central bank's footsteps for such a green revolution to be effective. From an operational standpoint, the idea is straightforward. In previous research, we have put forward that the central bank which issues a digital currency would make it available to non-banks and would back it by a very specific asset, for example, via a green bond³⁴.

Implications for asset managers

In our view, the investment industry is unlikely to suffer a disruptive and direct effect from CBDC. Whether a financial asset is settled via existing real-time gross settlement systems or via a system that involves a CBDC does not really make a difference. On the other hand, the option of depositing cash directly on the central bank's balance sheet might quickly drift into the money during a financial crisis. We should always keep in mind the big picture, though. The benefits of being allowed to deposit directly at the central bank may come at the cost of a higher risk and hence a different investment profile for the banking sector. Furthermore, in case of a mis-calibrated CBDC design, investors might eventually experience periods of increased asset price volatility – not to say financial instability. More research is needed on this front to better value the relative dynamics of risk premia that might (theoretically) result from the introduction of a CBDC. In that sense, we would argue the exercise of portfolio construction with, and without a CBDC, might result in different asset allocations.

Other issues

Above we have focussed on the most pressing points on the CBDC research agenda. However, the list is by no means exhaustive and other – perhaps less timely – topics should also be considered for the sake of completeness. One such topic is seigniorage, defined as the time value or carry of money in circulation. Shifting from unremunerated cash to a remunerated CBDC might affect seigniorage in different ways: *“...in addition to the direct effect on interest payments by the central bank (which would have a negative impact on seigniorage), it would have indirect effects by reducing the costs of supplying cash (positive impact) and by increasing the demand for central bank liabilities (positive impact). The overall effect is ambiguous, but it could be non-negligible and have non-trivial distributional consequences...the political economy consequences of this should not be underestimated”*³⁵. Furthermore, the interested reader might deepen their knowledge of CBDC by addressing topics such as central bank independence, the anonymity of payments, financial illiteracy and so on. And we should not underestimate the critical issue of redundancy. Every reliable

system should operate with enough redundancy in order to achieve a high standard of reliability and resilience. From that perspective, relying on a single technology in the context of delivering a strategic and essential service – for example a payment infrastructure – might not be the optimal design.

Ultimately, time will tell

Digital currencies are not a totally new instrument, but rather a natural evolution of money that somewhat closes the gap with the discontinuous technological progress that has disrupted our society over the past 30 years. The most stable form of a digital currency is CBDC: We have analysed the various aspects of a successful design, as well as key points on the future research agenda, including monetary policy and financial stability.

Policy makers should always bear in mind that currencies can be very powerful instruments on the geopolitical chessboard. In a recent report³⁶, we've stressed the acceleration in analyses and trials related to CBDC, as well as Beijing's leadership on that front. Questions about the future of the US dollar's monetary dominance as well as the future of traditional currencies arise naturally in this environment. Time will tell whether we're heading toward an ecology of traditional and digital currencies and which currency will ultimately enjoy reserve status in the long term. Time will also tell whether CBDC technology will be adopted universally or will be ultimately subject to something like a Galápagos syndrome³⁷.

In the broader context of a world order, however, CBDC might become a constraint to a global governance model that has its two pillars of hyper-globalisation and democratic policies. In fact, the introduction of a CBDC would almost necessarily reinforce the concept of national sovereignty, thus giving rise to the classic Rodrik trilemma³⁸. Interestingly, a similar argument has been addressed with regard to monetary and financial sovereignty by Panetta (2020): *“A digital euro would also protect us from the potential for a public or private digital means of payment, issued and controlled from outside the euro area, to largely displace existing means of payment, which could raise regulatory concerns and threaten financial stability or even our monetary and financial sovereignty.”*

³⁴ Tentori (2020)

³⁵ Panetta (2018)

³⁶ Tentori (2021)

³⁷ For example, Bofinger/Haas (2021) somewhat provocatively ask *“what is the market failure that would justify central banks entering business areas*

that have so far been operated by commercial banks and private retail payment system providers?”

³⁸ Rodrik (2011)

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