

A retail CBDC in Europe: the current situation and challenges

By François-Régis Benois, chair of the working group,
director of public affairs - La Banque Postale
and Louis Bertucci, rapporteur, scientific coordinator of the Finance and Insurance Reloaded
(FaIR) program – Institut Louis Bachelier

The monetary and payment environment is swiftly evolving, and most central banks are exploring the concept of a retail central bank digital currency (CBDC) as a response to the decreased use of cash and possibly to the emergence of so-called "stablecoins". The ECB has launched an investigation phase, involving many technical aspects, and will perhaps decide in the fall of 2023 to launch a realization phase.

At the time this debate paper is being drafted (March 2023), such a complex innovation still raises numerous questions, notably: which uses and purposes? What would be the consequences for the banking system? Which distribution pattern and economic model? How will it technically work? Will the public understand it and accept it? Beyond the technical features, what is the "normative frontier" that would have to be part of a democratic debate? How to reconcile the privacy of cash and the traceability of a digital substitute?

This Debate Paper¹ attempts to give an overall view of some fundamental issues for a wide range of players, from citizens and payment providers to regulators and legislators, and concludes with possible scenarios for the digital euro and stablecoins. It emphasizes that a digital euro seems to be more driven by strategic objectives – sovereignty notably – than by actual use cases which are not already covered by existing payment solutions. The main design choices, risks of over or under-adoption, and competition issues are also explored. Ultimately, legislative and political choices will be decisive, especially regarding legal tender, privacy, economic incentives, and the regulation of distribution.

It may be read in connection to the issue of the Revue d'économie financière on Digital currencies and cryptoassets (REF, 2023).

¹ This Debate Paper was prepared by a dedicated working group composed of representatives of institutional members of the AEFR participating in a personal capacity (see appendix) whose aim is to initiate a discussion on key issues at stake regarding MNBC. The views expressed in this paper do not necessarily reflect the views of the individual members of the working group. The study has greatly benefited from interviews carried out with key institutional and market participants stakeholders, who should be thanked for their very valuable contributions.

Introduction

Although electronic money has been available to the public for some time with the development of the internet, credit cards, and mobile phone communications, retail central bank money has essentially not evolved for centuries, and we still use physical banknotes and coins. Potentially increased competition from crypto assets has resulted in a worldwide interest in Central Bank Digital Currency (CBDC), and central banks around the world are looking into this, as evidenced by a regular BIS survey (Kosse et al., 2022). This debate paper attempts to provide a comprehensive overall view of the challenges in implementing a retail CBDC, with a focus on the European initiative. It concludes with a few proposals.

Over the past 14 years, digital assets have gone from an incidental blog post on a cryptographic forum to a multibillion-dollar global industry.² The first of its kind, Bitcoin, introduced the notion of digital scarcity obtained through decentralized consensus among anonymous participants. From then on, an era of rapid development of a decentralized industry started. Without entering the debate on the genuinely decentralized nature of blockchains, the development process is to a large extent decentralized. Although the first blockchains were quite powerful, they lacked technical capabilities. The following generation of blockchains, with the most prominent one being Ethereum, brought true programmability to digital assets. This has made possible the development of the Decentralized Finance (DeFi) ecosystem since 2017, with a boom in 2021.

Introduced for the first time with MakerDAO in 2017, stablecoins are crypto assets that are pegged to one fiat currency. Since then, stablecoins have grown in popularity and have been heavily used in the DeFi ecosystem. There are several types of stablecoins depending on whether they are collateralized or algorithmic, and how the collateral (and the peg in general) is managed. Although there are a number of associated risks, they offer a powerful way to use all blockchain features like smart contracts and fast payments with fiat-like instruments.

The rapid development of crypto assets has triggered various regulatory responses. China decided to ban crypto asset transactions and proof-of-work mining in 2021. In North America and Europe, rather than banning them, the goal is to create and adapt regulations to encourage innovation while protecting end users and investors entering this market. On the other side of the spectrum, El Salvador fully adopted decentralized assets and made Bitcoin legal tender in June 2021, while the Central African Republic also made Bitcoin legal tender in April 2022. Both digital currencies and stablecoins pose important risks that are often overlooked. Beyond the intrinsic technological risks, the market risk is important for both. Crypto currencies are highly volatile and subject to market manipulations. However, stablecoins are also subject to the market risk of the collateral that is used to maintain the peg.³

Since banknotes and later electronic money have been in use, money has been a liability. When the central bank is the debtor (banknotes, commercial banks' reserves), this is labeled central bank money, and when a commercial bank is the debtor (bank deposits), this is labeled commercial bank money. Even though these represent two

² In Q1 2023, the total market capitalization of all crypto assets was about \$1,2 trillion (Source: [Crypto.com](https://www.crypto.com)).

³ All stablecoins may be subject to bank runs regardless of the techniques used to maintain the peg. In the case of algorithmic stablecoins, there are high market risks, as was illustrated by the crash of Terra/Luna.

distinct forms of money, they are generally used interchangeably because it is convenient and ensured through various institutional arrangements (final interbank settlements using reserves, banking regulation and supervision, lending of last resort, and in some cases bailouts by the government). Retail users only have access to digital money through deposits and electronic commercial money, and commercial banks settle operations with each other by using central bank money, referred to as reserves.

Traditionally, the notion of money is defined by its three main functions. First, money is a store of value, which implies technology to transfer wealth over time. From this function follows the fact that the value of a currency should be relatively stable in terms of purchasing power. Second, money is a medium of exchange. This refers to the actual use of money to buy goods and services, using transactional technology. The final function, which is usually overlooked, is the unit of account from which the first two are derived. This means that money is used to measure the value of real assets and that prices of goods and services are defined by what quantity of this money is needed to buy them. Through the supply of reserves, central banks can conduct monetary policy because they can influence the price of money in circulation, which affects the level of economic activity and ultimately prices.

Whether it comes from centralized payment platforms or decentralized and blockchain-based solutions (that may or may not create alternative money), competition among different currencies or different forms of the same currency is likely to increase, and therefore the pressure to “upgrade” traditional money is high. CBDCs and stablecoins can materialize this upgrade idea. In particular, if properly designed, a CBDC has the potential of reducing transaction costs, enhancing anti-money laundering, and combatting the financing of terrorism (AML/CFT), and ultimately creating value for the population by having central bank money enter the digital age. This paper will discuss use cases, challenges, and legal implications.

Most central banks around the world have been looking into CBDC (Kosse et al., 2022). One of the first to move was China, which started working on this in 2015 and has been implementing a pilot project since 2020 (222, 2022). The Bahamas launched one of the first actual CBDCs in 2019 (Central Bank of The Bahamas, 2019).

The main motivations for initiating such projects are diverse. In China, cash usage is decreasing rapidly and the competition from payment platforms such as Alipay or WeChat has been intense, prompting the central bank to launch a CBDC as a substitute for cash. An important consideration is also sovereignty, of which two types have to be discussed. First, monetary sovereignty refers to the role of money as a unit of account and to central banks’ control over monetary policy. Second, technological sovereignty is also a concern, particularly in the matter of payment tools and design, which is why each central bank is pursuing its own research and development. At the end of 2020, the ECB identified 7 scenarios in which the issuance of a CBDC would be critical.⁴

Countries that are at different development stages may have different comparative advantages in creating a CBDC. According to Cong and Mayer (2022), countries with the strongest currencies have no incentives to be the first to act, while countries with the least stable currencies have an advantage in adopting a strong digital currency rather than developing their own CBDC. The countries with the highest incentives to act would be those with

⁴ The 7 scenarios are: 1) the digitalization and independence of the European economy, 2) the significant decline of the role of cash as a means of payment, 3) digital euro as an alternative medium of exchange and, potentially, as a store of value in the euro area, 4) a monetary policy perspective, 5) a need to mitigate the probability that a cyber incident, natural disaster, pandemic, or other extreme event could hinder the provision of payment services, 6) the international role of the euro, and 7) the overall costs and ecological footprint of the monetary and payment systems (ECB, 2020).

strong but not dominant currencies. For instance, from this point of view incentives would be greater for Europe to act than for the US.

The focus of this paper is the retail CBDC project of the euro area, also called digital euro. At the end of 2020, a public consultation was launched by the European Central Bank, which led to the start of a technical investigation phase in October 2021 for two years. During this phase, the goal is to identify potential use cases, address design questions,⁵ assess the risks that a CBDC might induce or could help reduce. Depending on the outcome of this phase, a development phase may be launched in October 2023 that would begin the implementation of the digital euro.

Given the variety of stakeholders, the potential risks, and the legal framework, designing a retail CBDC is challenging. Although some design choices are becoming more likely than others, there are still a number of decisions to be made. While the investigation phase is still ongoing, this debate paper attempts to contribute to the discussion by providing a comprehensive view of the current challenges and implementation issues, both at the technical and legal levels, while making targeted recommendations. Section 1 discusses the use cases of a retail CBDC, while section 2 presents the main challenges for all stakeholders. Section 3 focuses on general acceptability and the accompanying legal framework.

1. Which use cases?

Central bank money is currently being distributed in two main forms, each with different goals. First, banknotes and coins in circulation, also referred to as M0, dedicated to retail use, and second, central bank reserves, only available to banks and financial institutions which have accounts at the central bank, i.e., wholesale use. Banks can open an account at the central bank and use these reserves to settle interbank transactions.⁶ A CBDC may refer to either central bank form of money: retail CBDC, which would be accessible to the public, or wholesale CBDC, which would be accessible only to banks.⁷ Identifying actual use cases for each form of CBDC will determine the design and the implementation of a CBDC project.

Retail use cases

It has proven challenging to find proper CBDC use cases. This is one of the main criticisms that has been made against the development of CBDCs. We present below the main use cases that have been suggested specifically for a digital euro, but we remain cautious about their actual usefulness when compared to cash or other existing forms of electronic money and digital means of payment.

⁵ A “market research” was released on January 13, 2023, “to get an overview of options for the technical design of possible digital euro components and services”.

⁶ In general, banks are not required to settle their transactions in central bank money, although PSD 2 introduced the requirement to use central bank money only for systemically important payment providers. See also Principles for financial market infrastructures (BIS-CPMI-IOSCO), April 16, 2012; CSDR Regulation of July 23, 2014; EMIR Regulation of July 4, 2012; Directive 98/26/EC of May 19, 1998, on settlement finality in payment and securities settlement systems.

⁷ And possibly certain non-bank payment service providers, depending on a revision of the Settlement Finality Directive, see below.

Three major retail use cases have been identified: 1) Substituting for or complementing cash for daily payments, 2) Cross-border payments and remittances, 3) Innovation and programmability of money. These use cases are to be distinguished from policy macro-objectives such as preserving the monetary anchor, monetary and technological sovereignty, the currency's international role, or monetary policy transmission.

Substituting for cash in daily payments

In some economies, cash payments have been decreasing due to measures taken against hoarding and illicit transactions, so that M0 has barely changed in the recent period. If this trend were to spread to the euro area, this could affect the sustainability of the cash infrastructure, increasing its cost relative to the total amount of cash transactions.⁸ In the absence of a public alternative to cash, the economy might have to rely more on private alternatives. With a properly designed retail CBDC, just as with cash, there would be no counterparty risk for retail users. Although such a CBDC could lead to a less intermediated local payment infrastructure, it is likely to be just as intermediated as cash and would be provided through accounts and/or wallets.⁹ Indeed, no central bank is currently looking at distributing and managing the CBDC itself, so that some intermediaries will have to be involved (see below), which makes the advantage of a CBDC less obvious.

As we move deeper into the electronic age, it seems natural to let public forms of money evolve in this direction as well. But that may not be enough to guarantee its success and design, and its main characteristics will be important drivers of its ability to replace cash in an effective manner.

More specifically, daily payments in digital euros would include making and receiving person-to-person (P2P) payments, making payments to merchants (point of sale and e-commerce), businesses, or governments (P2G), as well as receiving payments from governments (G2P).

Cross-border payments and remittances

Cross-border payments and remittances are especially expensive when using the existing payment infrastructure. A CBDC could greatly facilitate such payments by making them globally accessible and less costly. However, there are important challenges related to interoperability, willingness to make CBDC accessible to non-residents, AML/CFT that will have to be addressed for this use case.

Within the euro area, the payment infrastructure has greatly improved over recent years through innovations like TARGET and TARGET Instant Payment Settlement (TIPS). At the same time, cross-border payments outside the euro area are still relatively expensive. For the retail CBDC to be used for such cross-border payments, non-residents would have to be able to open CBDC accounts or hold CBDC wallets, but there is no guarantee that this would be granted. Requirements and usage restrictions that could be imposed will be discussed next but those will also likely hinder the usefulness of CBDC for this use case.

⁸ See ECB (2020), scenario 2.

⁹ A wallet differs from an account because it is related to a private key, is subject to change of ownership, may hold distinct currencies and assets, and involves the creation of a token instead of a balance after each payment.

Innovation and programmability of transactions

Finally, a CBDC, because it is natively digital, could bring innovation and programmability to retail transactions in central bank money. Special forms of payment, like one-to-many payments or other transaction types inspired by crypto assets, could theoretically be made using central bank money. If the infrastructure (such as permissionless blockchain) allows, other innovations could also become possible, thanks to the programmability of payments using CBDC. For instance, a design choice could be to allow a piece of software (i.e. a program or “smart contract”) to be attached to a unit of CBDC, which would enable features like segregation, conditional and automated payment for social benefits, or even more fancy use cases in the Internet-of-Things. Beyond existing applications, all those innovations have the potential to create additional use cases, as well as additional risks. In particular, the issue of programmability is subject to cyber risks. Programmability will not be granted by default and will largely depend on the infrastructure used (blockchain based or not). Without a blockchain, which is currently a likely path for the digital euro, programmability would have to be supplied through an additional layer or services, if this is deemed important. Furthermore, the same attributes could be attached to stablecoins, even more safely than to CBDC since they all use the blockchain.

Considering those three macro use cases, the added value of a CBDC regarding other solutions, like traditional payment service providers or stablecoins, is essentially the absence of counterparty risk. Central banks deem it important to keep an active and direct role in providing the population with sound and stable money, either in a physical or digital form.

Wholesale use cases

Central bank money at the wholesale level may also benefit from the introduction of a CBDC. In 2020-2021, the Banque de France conducted several experiments regarding the use cases for a wholesale CBDC (Banque de France, 2021). These experiments showed that the two major use cases for which a CBDC could be useful concern the settlement of tokenized assets (notably crypto-securities) and cross-border payments between financial institutions. We purposely are not developing these points here since the focus of this debate paper is the retail aspect of CBDC.

Comparative analysis of different forms of money

	CBDC	Unregulated Stablecoins	Regulated Stablecoins	Cash	Bank Deposits
Privacy	TBD but less than cash	Pseudonymous	Pseudonymous	Anonymous	Confidentiality vis-à-vis external parties
Financial stability risk	Medium (disintermediation)	High	Medium (disintermediation)	Medium (disintermediation)	Low
Security and cyber risk	No counterparty risk / cyber risk	High counterparty risk / cyber risk	Medium counterparty risk (from the issuer) / cyber risk	No counterparty risk / cyber risk	Medium counterparty risk / cyber risk
Transaction finality	Instantaneous (potentially offline)	From instantaneous to hours	From instantaneous to hours	Instantaneous	From instantaneous to days
Cross-border payment	TBD	Easy	Easy	Very expensive	Expensive

Several forms of money are currently being used at the same time, which creates some fragmentation, both geographical and technological. The introduction of yet another form of money may very well increase this fragmentation even more and limit adoption. Consequently, some level of interoperability will be necessary, which also has important consequences regarding potential usage limitations of CBDCs. Section 3 addresses these issues.

What are ultimately the use cases?

Regarding both retail and wholesale CBDC, several potential use cases have been highlighted. Certain features – and structural choices – will likely be technically and legally required in order to facilitate adoption by the general public (for the retail CBDC) and by financial institutions (for the wholesale CBDC). Although a consensus has begun to be reached on some of those characteristics, there are still several uncertainties.¹⁰ Here are examples of those design characteristics:

- Daily payments: A retail CBDC would be used for payments to merchants, businesses and governments, possibly with P2P payment and without preventing future developments like person-to-machine,

¹⁰ As will be outlined in a later section, here are some of the characteristics on which there seems to be a consensus: i) distribution only through regulated intermediaries, ii) the Eurosystem will manage a centralized and anonymous register that will be directly updated by intermediaries, iii) semi-data privacy, iv) usage limitations, v) online and offline availability.

machine-to-person, business initiated, internet of things, etc.

- Traceability vs. anonymity or pseudonymity: transaction recording is of particular importance regarding user privacy and may be incompatible with AML/CFT requirements. The current most likely design of the digital euro is to make small transactions pseudonymous. Too little privacy may indeed hinder adoption.
- Payment account vs. token: This is an important design choice that is linked to the issue of privacy. Token-based CBDC naturally improves privacy while account-based facilitates third-party control.
- Online only vs. offline availability: Cash is inherently offline, and this property would probably be an important determinant of adoption. Moreover, requiring exclusively online use would also limit financial inclusion, since some users may not have continuous internet access or are not familiar with digital usage.
- P2P validation vs. trusted third party: P2P validation is less likely to be implemented, at least initially, except for the offline system.
- Interoperability and blockchain as the underlying infrastructure: It is currently very unlikely that an open blockchain would be used. The issue of interoperability has yet to be settled.
- Balance and payment limitations: As will be explained in the next section, some transaction and/or holding limits are likely to be implemented with several goals in mind, including limiting AML/CFT risk and reducing the “over-adoption” risk.

Given the diversity of use cases then, getting the initial CBDC design to fit all requirements seems to be a challenge. The question that arises is how to select and rank use cases. In this respect, care should be made to understanding where a CBDC would have the most impact while solving a practical problem. There are also strategic considerations. Among these, some level of competition among the world's top currencies will have to be taken into account.

At the European level and in theory, it seems that a retail CBDC does not serve any new and obvious use cases compared to physical cash and the numerous existing payment solutions,¹¹ except for uncertain programmability through smart contracts (possibly at a later stage), which stablecoins can also provide. Still, a “replication” of physical cash or deposits may also be justified in order to “stay in the race” of innovation.

Risks associated with launching a retail CBDC

Introducing a retail CBDC is often associated with two major risks: under-adoption and over-adoption (Panetta, 2022). Both risks are not equivalent: while central bankers want to avoid launching a CBDC that would not be used, other stakeholders and in particular commercial banks perceive the over-adoption risk as being much more critical.

Under-adoption

The cost of developing a CBDC for a currency on the scale of the euro would be quite high. Moreover, it could only be a non-obligatory technological tool provided to the people of Europe (people could still use bank deposits, cash, or other forms of money if they prefer). The risk is that the project would simply fail, possibly due

¹¹ Such as contactless payment, transfer initiation, or SEPA instant payments, the adoption of which was encouraged by the European Commission through a regulation proposal (European Commission, October 2022).

to restrictive design choices, or just because it does not correspond to possible use cases. As previously mentioned, the absence of clear added value through new use cases is a major issue, and it will necessarily weigh on the ultimate decision to launch a CBDC. It is likely that issues related to privacy and usage limitations would be of high importance for citizens, as the public consultation carried out by the ECB in 2020 made clear. In that regard, there is a trade-off between the currency the public would want to use and what would be desirable from the point of view of the regulator. The regulator cannot afford the risk of designing a new form of money that would facilitate money laundering. Accordingly, some level of Know Your Customer (KYC) would have to be carried out.

In that respect, CBDC would be closer to bank deposits than to cash, which is a lot less regulated. This would have the potential of radically modifying the competition between commercial bank and central bank monies.

Over-adoption

A retail CBDC would ultimately compete with all forms of money, including cash and bank deposits, and if it were broadly adopted that would change the structure between the quantity of bank deposits and other financing sources in commercial bank balance sheets. In principle, it would be similar to a bank run (i.e., people converting commercial bank money to central bank money), except that it would not affect just one bank but might destabilize the whole financial system. In a study published in May 2022, the ECB evaluated the impact of a digital euro on deposit substitution at between 0.5% to 18% of aggregate euro area bank liabilities (according to various scenarios) and considered it “manageable” in terms of financial stability and intermediation capacity (ECB, 2022a).

With fewer deposits, which are essentially a low-cost resource for commercial banks, commercial banks might have to turn to more expensive financing, such as wholesale markets, and see their liquidity ratio requirements increase, which would increase their financing costs and make their funding more volatile.¹² This could in turn decrease the quality of bank collateral posted with the ECB and limit banks’ capacities to ensure transformation and finance the economy. In addition, in times of stress, commercial banks that are less robust might see a high rate of conversion between their deposits and CBDC because the counterparty risk of the commercial bank would start becoming too high compared to that of the central bank.

This risk arises because since World War II the financial system has progressively marginalized central bank money. Most of the money in circulation is currently created by commercial banks through loan distribution. If the public, instead of keeping deposits, were to convert that into central bank money, commercial banks would have fewer incentives to grant loans in the first place. This would also temporarily affect the monetary policy transmission channel of which commercial banks today are a major part, although the transmission channel could also be strengthened through other means, for instance if the CBDC paid interest. Indeed, if the central bank could choose the interest rate paid on CBDC deposits, it could directly affect the consumption to saving ratio.

¹² Note that such an impact on bank refinancing could theoretically be softened through a specific instrument such as a “new TLTRO”, but the recent period has shown that this perspective is unlikely in times of rising and positive interest rates.

2. Challenges, constraints, and opportunities for stakeholders

The introduction of a CBDC would involve a large number of stakeholders. They each have their own challenges, opportunities, and constraints, which may not be aligned. Public authorities who are examining the possibility of introducing a CBDC must keep this general picture in mind in order to avoid missing critical aspects of this new value chain.

Central banks

Central banks oversee monetary policy and also, in conjunction with other public institutions, financial stability. As mentioned above, they currently issue central bank money in the form of banknotes and reserves; CBDC would be another form of such central bank money. Many of them, including the ECB, have started conducting research and experimenting in CBDC.

Central banks are also getting more concerned about technological innovation and financial stability, which is one reason why the ECB is looking into CBDC development. Regarding technological innovation and sovereignty, the central bank is not a tech company and may not itself possess the teams necessary for the development of a large-scale form of digital money, let alone want to cover the administrative costs associated with KYC. Subcontracting is likely to be required for the actual implementation of a CBDC project, and this will not necessarily mean turning to European providers. The technological stack is a critical issue since this introduces another layer of potential risks. Central banks may also choose to delegate the implementation, distribution, and maintenance to commercial banks (the most likely plan of which is detailed in section 3), but a solid business model would be required so that banks act in the best interests of society. This is far from obvious. The central bank is essentially looking at a CBDC that would be free for end-users (like cash), while some players in the value chain would have to pay intermediaries to link their services to the CBDC.

Central banks are also concerned with financial stability, which may be jeopardized if the CBDC is over-adopted. In an extreme case, a massive conversion of deposits into CBDC would be equivalent to a bank run and might trigger the failure of some of the least solid banks.

Public Authorities

Even if the central bank has the authority to issue a CBDC, the European Commission, the co-legislators and other regulatory agencies will define the global framework and legal status of a digital euro.¹³

A CBDC would operate in a payment network and be based on a technological stack and a user interface that would have to be developed. European public authorities may be interested in decreasing the level of dependency on non-European intermediaries, in particular the Big Tech firms. The lack of dominant European players in the current payment infrastructure could be overcome by the well-executed deployment of a European

¹³ See section 3 for a more detailed view of the European institutions at stake.

CBDC and its associated payment infrastructure, either through the underlying infrastructure or through front-end user interface tools. The European Payment Initiative (EPI) is a step in this direction. Supported by the Commission, the ECB, and some major European banks, its explicit goal is to create a pan-European payment system and interbank network, mainly leveraging instant payments.¹⁴ EPI has been selected as one of the five companies that is to create a joint prototype of the CBDC user interface (ECB, 2022b).

Public authorities are also concerned with adverse consequences on financial stability and positive consequences for states' budget financing. If there is a high rate of adoption by retail users, bank deposits may shrink, which can ultimately have consequences for bank refinancing. In terms of budget financing, "seigniorage" should increase for the central bank, since issuing CBDC units should be cheaper than cash, and the substitution of a CBDC for cash could reduce tax evasion.

Finally, public authorities are obviously concerned with AML/CFT regulations. Full traceability can help determine which transaction is "authorized" according to AML/CFT regulations, but it may create an important single point of attack, for instance through a global register maintained by the Eurosystem. Such vulnerability may exceed the critical loss of privacy that would result in the identification of the sender and the recipient for all transactions. Another way to counter criminal use of the CBDC is to limit its usage, for example, by limiting the balance of each account and/or the amount available for an operation over a given period. But this goes against user flexibility.¹⁵

Commercial Banks

The major threat to banks of CBDC adoption is the effect on customer deposits, which represent a significant proportion of most European bank balance sheets, and ultimately on banks' asset-liability management (ALM). As a proportion of deposits migrate into a CBDC, commercial banks would be left with the original interest rate hedges against these deposits. It is assumed that commercial banks would close out this new interest rate risk position. The closure of this position would reduce the capacity of banks to lend at fixed rates (thus potentially transferring the interest rate risk to the customer with loans at variable rates), since sight deposits are usually remunerated at zero or close to zero and used to hedge 15-20 years fixed rate mortgages that are very popular in France (90% of loans) and other European countries. Indeed, the creation of a CBDC would affect the volume and modeling of deposit accounts: a portion would be transferred to CBDC and the remaining non-CBDC intermediated deposits would be deemed less stable. This would change the business models and the number of fixed rate mortgages would be reduced.

The ECB has been willing to reassure banks that there would be enough usage limitations on the CBDC so that a possible impact on balance sheets would be manageable. However, the situation might be more complex, for example in times of crisis or depending on the heterogeneity of bank dependence on the collection of deposits. If a bank's customers start perceiving a counterparty risk on their savings, they might be tempted to convert their deposits into CBDC. The increased bank run risk could also modify banks' incentives in the first place, thus resulting in uncertain effects on financial stability. Note that strong usage limitation may not hold in times of crisis as CBDC convertibility can lower the effect of a crisis in at least three ways: 1) payment continuity outside the financial system is critical for avoiding a follow-up economic crisis, 2) convertibility is probably better than capital outflow

¹⁴ The list of founding partners can be found here: <https://www.epicompany.eu/>.

¹⁵ See section 3 for a more thorough discussion on this privacy issue.

(especially in non- or less cooperative jurisdictions) and 3) depositors could in any case shift to stablecoins, cash, or Treasury bills.

Although the competition on payment services is already intense with mobile banking and payment platforms, competing in particular with cards and cash, the introduction of a CBDC would likely increase it. This would generate a playing field in which central bank money would be in competition with deposits. However, given the fact that banks will likely be the distributors of CBDC, probably together with other payment service providers (PSP) due to legal and level playing field considerations, the incentives for banks will be complex. In particular, the design of the economic model will be critical. It should not discourage banks from distributing CBDC, since there are costs related to the infrastructure, KYC requirements, and possible conversion of deposits. This will be even more true if direct funding and defunding with cash is foreseen, as it will require investments to upgrade ATMs and software. If banks have to cover these costs themselves, they will probably be transferred to retail users at least partially through a range of fees related to CBDC and other ancillary services. This is an important question, since the ECB would prefer a CBDC that is free to use, similar to cash. On the other hand, one should also bear in mind that the remuneration of cash at a zero-interest rate has enabled banks to remunerate sight deposits at a zero or close to zero interest rate. One way to incentivize banks to distribute CBDC would be to also allow other payment service providers to do so, giving them conditional access to central bank money.

Payment Service Providers and Big Techs

With the advent of the internet, and in particular mobile communication, many alternatives to the traditional financial system have emerged in the field of payments. Payment platforms and payment service providers have been joined by pure tech companies that have managed to increase quite significantly in size, including Big Tech firms. However, most of the incursions of Big Techs in the field of payments, the most recent being Libra/Diem, have proven unsuccessful. Even the most celebrated of these incursions, Apple Pay, has not been able to gain a significant market share in China.

Those tech companies have proven their expertise regarding the speed of innovation and the ability to provide clean and intuitive User interface (UI) and User experience (UX). This ability may help them differentiate themselves from banks and explore new paths for integrating personal payment data in their services and ecosystems. Indeed, a retail CBDC will likely be interoperable with other payment systems, which means that anyone will be able to build a UI that links the CBDC account or wallet to an existing application with value added services instead of having a dedicated application just for the CBDC. Distribution of the CBDC will likely be operated by banks and other PSPs, but this raises the problem of the economic model, as mentioned above.

Overall, PSPs and Big Tech firms would be better off if no usage limit were placed on them, since they would probably provide the best UX and therefore take some deposits from banks, unless regulation prevented them from keeping the funds of their customers. They would also probably simplify the KYC process by incorporating some degree of automation.

Among the five companies selected by the ECB (2022b), as part of the two-year “investigation” phase, each of them focuses on one specific use case: two banks (CaixaBank and Nexi), two payment service providers (Worldline and EPI), and one retail online merchant (Amazon). It will be interesting to follow the outcome of this phase to

see how Big Techs like Amazon can really compare to traditional and specialized actors when it comes to payment user interface and ultimately adoption.

Merchants

Merchants will be among those most affected by a retail CBDC. Whether acceptance of CBDC payments is made mandatory or not, it is important that they clearly perceive the added value of such an innovation.

The critical question for them will concern the practical usage of the CBDC. They will profit from a low cost CBDC offering high interoperability with other payment systems, a strong level of security, and fast settlement and transaction finality. The question of whether merchants will be legally required to accept the CBDC or not is not straightforward, as we will see in the final section of this paper. It also raises the question of business models and interchange commissions for distributors.

The issue of interoperability with existing hardware is also critical for merchants since it would avoid them having to buy dedicated and potentially expensive devices and ultimately encourage adoption.

Corporations

Corporations may also have some stake in a CBDC project, primarily a wholesale CBDC.¹⁶ Firms operating in different economic areas may find it advantageous to use a CBDC for cross-border payments among subsidiaries. Another use case of wholesale CBDC for large firms is settling large transactions along the value chain. A programmable CBDC may prove very helpful in such a context for payments that depend on delivery or insurance, for example.

Still, a retail CBDC raises the question of its “accumulation” and use by retailers and mass distribution, and to a lesser extent by public administrations. Whether they would have to transfer amounts of CBDC to bank accounts on a continuous or daily basis and be able to use them for BtoB transactions remains to be clarified.

Retail users

For a retail CBDC, end-users will of course be at the center of the adoption process. In March 2022 the ECB published a report on payment preferences for different categories of retail users and merchants (Kantar, 2022). Retail customers would value universal acceptance, the ability to make instant, contactless, and open P2P payments, a one-stop-solution, as well as easy and fluid onboarding. In this sense, interoperability would also be important. The ability to integrate the CBDC into their own open banking applications would help make the CBDC convenient for daily use.

¹⁶ Large corporations may also be interested in retail CBDC in the sense that their employees may prefer at some point to receive their salary directly in CBDC. Therefore, interoperability and convertibility between retail and wholesale CBDC would have to be taken into consideration.

Privacy is also deemed a major concern for retail users.¹⁷ The public is now aware of the negative consequences that can result from data leaks, amplified by scandals and revelations made by international journalist consortiums. However, it seems that in practice most people do not attach much importance to privacy, or at least continue to massively use services like social media that are intrinsically fueled by shared personal data, despite better client monitoring made possible by the General Data Protection Regulation (GDPR).¹⁸

As for traditional banking, regulation is somewhat different, but retail users do not really have a choice. Whether it is banks or PSPs and BigTech firms, they all collect data on their customers. Only stablecoins can implement true transaction privacy.¹⁹ A central bank issuing a CBDC would have to implement some privacy protection features. One design choice would be to choose between account-based CBDC or token-based CBDC.²⁰ While an account-based CBDC could easily be audited, a token-based CBDC could have different privacy features, potentially assuring “progressively” privacy based on quantitative thresholds. Given the remarks on privacy, a token-based CBDC would probably be preferred by retail users.²¹

In terms of preferences, retail users would be concerned with the security and simplicity of their daily transactions and the general acceptability of CBDC, including for peer-to-peer transactions. The CBDC design, among other features, would have to envisage two options: online use only (like deposits) and offline availability (like cash). In order to increase use, a CBDC would have to be available both online and offline. One way to make offline payments available would be through a dedicated secure element, such as a tamper-proof chip with pre-installed software, that could activate all the usual checks a third party would need for online payments.

Simplicity of use for end-users would also be enhanced through compatibility between holding limits and frictionless payments, which can be achieved with a dual automatic waterfall mechanism, functioning both upon receipt of payment and as a reverse waterfall upon issue of the payment order (see below).

Potential design choices for the digital euro

As part of its investigation phase, the ECB has initiated a recurrent dialogue on the digital euro in the Euro Retail Payments Board (ERPB meetings) for market players to express their views and concerns about retail payments and specifically about the digital euro. While several design choices must still be made, the overall shape of the digital euro has become clearer, if it is launched. According to recent ECB documents, the following characteristics

¹⁷ The European Data Protection Board (EDPB, 2022) and the French data protection authority (CNIL, 2023) have also expressed concerns on the potential consequences for privacy. They have made proposals on “key points for a privacy-friendly digital euro by design” (mainly an offline electronic wallet, privacy thresholds, and a specific legal regime) and called for democratic vigilance in order to comply with GDPR or Articles 7 and 8 of the European Charter of Fundamental Rights.

¹⁸ In the ECB survey on new digital payment methods, privacy is explicitly not seen as being the most important feature.

¹⁹ Stablecoins may not be fully private but true privacy is possible to implement on blockchain-based stablecoins, for example with the use of zero-knowledge proofs.

²⁰ An account-based CBDC would have an infrastructure very similar to bank deposits, that is, the balance of each account would be maintained and updated after each transaction. In a token-based CBDC, users exchange units of CBDC (similarly to the use of cash) and the system keeps track of who owns each unit of CBDC.

²¹ Although an account-based infrastructure would probably better implement AML-CFT regulation, for example. Note that even if a token-based infrastructure can seem different from what the public is used to, this could be made abstract in the front-end interface so that end-users would not even know what type of infrastructure they would be using.

are likely to apply to the digital euro (ERPB meetings, ECB, 2022c):

- Distribution only through regulated and registered actors (banks and other PSPs managing accounts): the Eurosystem only takes care of issuance, settlement (full or partial), and registration of the digital euro.
- The Eurosystem provides an open architecture in an Application Programming Interface (API)-like format upon which all supervised intermediaries can build their own end-user application. This will require at least two types of plans: technical and commercial.
- Semi-data privacy: the Eurosystem will not be able to infer end-users' balances and payment patterns, but supervised intermediaries will be responsible for verifying the integrity and compliance of each transaction and as such will have the data on their users. There will be no AML checks for small payments in accordance with "selective privacy".
- Usage limits for total balance and daily transaction volumes.²²
- Interactions between commercial bank money (payment accounts) and the digital euro through (i) funding/defunding at the client's initiative and, according to payment amounts, (ii) default waterfall and reverse waterfall (see below).
- Online and offline availability (available 24/7).

Given those characteristics and the previous discussion, we see that AML/CFT concerns have been deemed more important than user privacy, since the digital euro would not tend to be anonymous, especially considering its non-physical nature. This would make the e-euro more similar to deposits than to cash. On the other hand, usage limits will probably be instituted to protect the stability of the financial system by preventing "over-adoption". In terms of interoperability, the potential design is still being under consideration, as is the technical infrastructure for distribution and settlement (distributed, centralized, or semi-distributed patterns).

In terms of the transactional system, the two mechanisms that have been selected for the initial implementation are third-party validation for online payments and peer-to-peer validation for offline payments. A peer-to-peer validation for online payments would also be technically possible but has been judged too experimental for the first phase of development.

Overall, the ECB will have to take a stance on some very important design aspects of a CBDC and may find it difficult to design a CBDC that represents an improvement over stablecoins and bank deposits (or PSP infrastructure) regarding privacy and usage limits. Section 3 below develops some of the potential design choices regarding legal boundaries in more detail.

3. Legal aspects, distribution model, and acceptability

Legal framework

Although money is a financial and economic tool, it must be part of a legal and regulatory framework, which cannot be ignored. In the case of Europe, several institutions have a major role to play. The ECB is the most obvious stakeholder since it is in charge of monetary policy and financial stability and manages the supply of

²² These limits could be defined in the final implementation phase in order to take the economic and monetary context into account.

central bank money that the CBDC would be a part of. The European Commission, as well as the co-legislators, the Council and the European Parliament, are also critical institutions in the adoption process. Indeed, some design choices for a CBDC may have consequences, for instance, that deal with data privacy or financial inclusion, which are concerns usually addressed by the Commission, the Council, and the European Parliament, and are beyond the mandate of the ECB.

More fundamentally, the functions and uses of money, beyond its technical features, relate to social behavior, economic equity, and individual liberties, making the project of a CBDC a democratic and political choice. Given the potential legislative and political implications, the European Commission has announced two draft legislative proposals for the end of the first semester of 2023 that address respectively the legal tender question and the fundamental characteristics of the digital euro.

Finally, several government-level institutions are also at stake. For instance, national central banks and other national regulators will oversee designing and enforcing the AML/CFT legal framework. There are several treaties, directives, and regulations that the newly created CBDC will have to comply with, and which may require modifications. The Treaty for the Functioning of the European Union (TFEU) contains, among other things, articles on economic and monetary policy, including the euro. The Revised Payment Service Directive (PSD2) (European Parliament and Council, 2015) regulates payment services and payment service providers with the goal of increasing competition and creating a level playing field in an integrated pan-European payments market. The Electronic Money Directive (EMD) (European Parliament and Council, 2009) regulates electronic payments and is intended to guarantee secure electronic money payments. More recently, on April 20, 2023, the European Parliament adopted the Markets in Crypto Assets Regulation (MiCA) (European Parliament, 2023), which will be the most substantial regulation yet on crypto asset service providers (CASPs, authorized by the national competent authorities) and stablecoins (which will be supervised by the European Banking Authority).

Nature of the digital euro

The first legal question that comes to mind regarding the introduction of a CBDC is its nature with respect to current regulations. One approach to answering this question is to look at the anticipated uses of the digital euro. There are several legal solutions for launching a CBDC. If it is viewed as a digital version of the banknote, then it would fall under the TFEU, which deals with the definition and scope of the fiduciary euro.²³ It should be noted that if the CBDC is assimilated with banknotes when it is issued, that would have meant it would bear no interest. Another possibility would be to launch the CBDC as a new form of money. In that case, the consequences for the TFEU are not clear, but it is likely that the ECB and the Commission would try to find a way to issue the CBDC without changing the Treaty, given the institutional constraints, political uncertainties, and delays such a revision would involve.

²³ TFEU Article 128.1: “The European Central Bank shall have the exclusive right to authorise the issue of euro banknotes within the Union. The European Central Bank and the national central banks may issue such notes. The banknotes issued by the European Central Bank and the national central banks shall be the only such notes to have the status of legal tender within the Union.”

The legal tender status

Another important issue relates to legal tender. This is probably the thorniest question since several consequences are linked to it. In Europe, legal tender status is governed in the TFEU²⁴ and the Council Regulation on the introduction of the euro, respectively (European Parliament and Council, 1998). for banknotes and coins.²⁵ According to those texts, legal tender means that if the two counterparties of a transaction cannot agree on the means of payment, the debtor can decide to force settlement in legal tender, which will settle the debt. Economic agents are not prevented from using other forms of means of payment. In particular, bank deposits are often used as means of payment without having legal tender status. Despite this broad definition of legal tender, actual implementation can depend on each EU country. For instance, whether cash can be refused if the merchant does not have enough change, limits on payments in cash,²⁶ or how to treat online purchases for which cash is much less convenient, is left to member states' specific regulations.

In the CBDC context, this means that if the digital euro were to be assimilated to a digital form of banknotes, it would trigger legal tender status, but there would still be room for interpretation and uncertainty surrounding actual national-specific regulations. Addressing this issue then raises the question of a higher level of harmonization in the EU. On the economic side, a CBDC with legal tender status would encourage adoption by dispelling uncertainties regarding the acceptance by merchants. Furthermore, legal tender status would potentially foster financial inclusion.

In that respect, the Commission could seize the opportunity of the digital euro to better harmonize the legal interpretation and practical implementation of legal tender status, basing itself on Regulation no. 974/98 (Council, 1998), Recommendation 2010/191/EU (Commission, 2010), and on an important January 26, 2021, decision of the Court of Justice of the European Union (2021).

Leaving aside legal and state-specific considerations, the issue of legal tender status raises the question of infrastructure, its costs, and who should bear them if distribution by payment providers and acceptance by merchants are mandatory. One question is whether merchants would be required to buy new payment terminals or if the CBDC could be easily integrated within the existing payment infrastructure. Such interoperability would greatly facilitate adoption on the merchant as well as on the customer side.

Distribution and business models

The distribution system that is currently being explored is a system in which the Eurosystem would only carry out

²⁴ Id.

²⁵ See https://economy-finance.ec.europa.eu/euro/use-euro/euro-legal-tender_en.

²⁶ For instance, the absence of a ceiling in Germany is well-known, although the German government has recently been considering introducing a €10,000 limit.

issuance, settlement, and registration of the digital euro, while private actors would take care of everything else. These private actors will have to comply with numerous obligations and will be supervised by the Eurosystem.

The revised Payment Services Directive (PSD2) of 2015 lays the ground for increased competition in payment services, in particular from non-bank players, while increasing the security requirements of online transactions. It creates different statuses regarding the nature of the services provided. In the current proposition, the way PSD2 defines PSPs (including e-money institutions and payment institutions) would fit the digital euro requirements that include but are not limited to: i) offering payment services, ii) providing accounts, iii) making APIs openly available, iv) offering other basic services. However, limiting distribution of the digital euro to those PSPs that are registered for the provision and management of payment accounts should be considered. Furthermore, the way legal status is handled by legislation will have a direct bearing on a possible revision of PSD2, since its Article 4 defines “funds” by direct reference to banknotes, coins, scriptural money, and electronic money.

The older EMD (European Parliament and Council, 2009) regulates entities that issue electronic money, defined as an “alternative to cash”. Most actors therefore fall under the scope of PSD2 and the EMD. Although the ECB is usually exempt from such regulations, given the variety of actors at play in the distribution and management of a CBDC there could be room for a merger between PSD2 and EMD. In fact, the European Banking Authority (EBA, 2022) sees an opportunity there, as such a merger could reduce regulatory uncertainty, ultimately improve harmonization and reduce regulatory arbitrage opportunities.

These registered intermediaries would be responsible for the onboarding and offboarding of end-users as well as regular relationship management and payments initiation. During onboarding the critical operation of KYC would be performed through all the checks that are already carried out to manage deposits. When initiating a payment, a PSP must ensure that the transaction does not violate AML/CFT rules. This would minimize the information that is passed on to the settlement layer, since the Eurosystem would trust the PSP verifications and would not need precise information about the details of a given transaction to validate it.²⁷

Digital euro distributors will also be responsible for funding and defunding value to and from the digital euro wallets of their clients. As in the system under consideration, these functionalities should be available on a permanent basis and be instantaneous. The management of funding and defunding could involve dedicated liquidity accounts, similar to Dedicated Cash Accounts (DCA) open to settlement in the TARGET system. This would mean granting non-bank authorized distributors (conditional) access to central bank money and a revision of the so-called Finality Directive (European Parliament and Council, 1998). However, such a change would have to be cautiously assessed, given its global implications on monetary policy and financial stability. As mentioned above, waterfall and reverse waterfall should also be implemented to account for usage limits. To ease this process, an external account would have to be linked to the digital euro wallet so that digital euros would be automatically converted to deposits when limits are reached.

The business model for those intermediaries is yet to be determined. While the digital euro will be globally accessible across the euro area, it will require commercial banks and PSPs to take a large number of actions and make costly investments,²⁸ let alone suffer loss of income depending on the magnitude of deposit migration.

²⁷ The Eurosystem will obviously be required to perform frequent audit of supervised intermediaries.

²⁸ Such as the provision of end-user interfaces and support, opening and holding of accounts and wallets, management and validation of payment operations, upgrades of ATM hard- and software, conversion in cash and commercial euros, KYC and AML-

Indeed, this is different from private forms of money since deposits are on the balance sheet of the associated PSP and can therefore be used to run operations and balance assets and liabilities. On the other hand, even if a PSP manages a digital euro account, the liability is actually on the balance sheet of the Eurosystem and cannot be used by the PSP on its own.

This creates an actual need to build a proper compensation model and create economic incentives for these services performed by registered intermediaries. Whether it will be through charging merchants for the provision of digital euros and devices, usual interchange fees (making a parallel between digital euro funding and cash withdrawal), interest perceived on the amount managed, pricing of value-added services, a new ECB tool, or another method is yet to be determined. As an extension of cash, the ECB considers digital euros to be a public good and as such, a free means of payment (at least for basic and necessary services) for private individuals.

Given the structural importance of this business model, it seems highly desirable that the future European legislation establish at least basic principles on the costs borne by the Eurosystem itself (as with fiduciary money) and on “reasonable, fair, and non-discriminatory”²⁹ compensation (including marginal costs) for intermediaries that will be legally compelled to provide digital euros.

Adoption and consequences

The introduction of a CBDC is inherently associated with a democratic process. But in the end, the population will get to choose what form of money (cash or equivalent, stablecoins, deposits...) it prefers to use in its daily activities.

Competition with existing infrastructure

In terms of competition, and leaving cash aside, a CBDC’s two major competitors would likely be bank deposits and euro-stablecoins. The main European payment infrastructure that bank deposits can use is the TARGET payment system, which is the European real-time gross settlement system. Launched in November 2018, the TIPS is a powerful tool provided to PSPs so that they can offer their customers near real-time settlements with immediate finality. SEPA, on which TIPS is based, is also an important tool for reliable bank transfers across Europe. Those payment systems appeal to customers and are heavily used. The goal of a CBDC should not be to replace them, but rather to work parallel to them. As previously mentioned, economic agents will in the end use the system they find more convenient.

As discussed in the first section, stablecoins are a direct competitor of a CBDC and this industry is still mostly in its development phase. In its current form, the recent Markets in Crypto Assets (MiCA) Regulation will ultimately impose strong collateral constraints on stablecoin issuers. A clear advantage of stablecoins is their native blockchain support and their use in DeFi applications. A high degree of programmability may be a feature economic agents will opt for. In that regard, it is likely that the CBDC will not – at least initially – be set up on a blockchain. So if it appears that programmability is something users demand, that will have to be implemented

CFT checks.

²⁹ As provided, for instance, in the Proposal for a regulation (...) on harmonized rules on fair access to and use of data (Data Act), issued February 23, 2022.

non-natively later on. Note that although stablecoins would not be legal tender, that would not prevent them from being used in business transactions like bank deposits.

To complement this landscape, let us mention that the German Banking Industry Committee (GBIC) has issued a proposal called “Commercial Bank Money Token” (CBMT), which would represent an evolution of commercial bank money (Die Deutsche Kreditwirtschaft, 2021 and 2022). CBMT aims to leverage Distributed Ledger Technologies (DLT) in order to offer commercial bank money new technical capabilities. The GBIC argues that, given the threat to the financial system imposed by CBDC, commercial banks should propose an alternative to forms of public CBDC money and to other forms of private money such as stablecoins. This is still very much in the discussion phase, but if CBDC is the central bank answer to the digitalization of money, CBMT would be the commercial banks’ answer. However, it should be noted that with the ECB’s current proposed distribution scheme, commercial banks would also be in charge of distributing the CBDC, so commercial bank incentives may not be optimal if they are offering both CBDC and CBMT.

Usage Limits

There are at least two reasons to impose usage limits on the CBDC. First, as explained above, it may lower the risk of over-adoption that could potentially hinder financial stability. Second, it could also limit money laundering activity in case of an unexpected failure of AML/CFT checks by intermediaries. Usage limitations might place limits on account balances as well as set payment limits. This could concern single transaction amounts but also total daily and weekly amounts so as to avoid large transactions being split up into multiple small transactions.

This raises an important paradox for the central bank: how to create a CBDC that attempts to identify the best use cases in order to bring value to the European payment system and at the same time limit its usage so that the digital euro does not jeopardize how banks are normally funded. The current financial system, which relies heavily on the intermediation role of banks, is not designed to function with substantially lower bank deposits. However, if the trend is sufficiently strong, one day or another an innovation will break through, rendering a too restrictive CBDC obsolete.

From a practical point of view, implementing such usage limits is far from obvious. There are already limits on the use of cash in the euro area, but this is what makes it challenging. If the digital euro were to be treated as a digital version of cash, limits should be the same as for physical cash, that is, country dependent. Indeed, some countries, like France, Italy, or Spain, have payment limits, while there are no limits in other countries, such as Austria, Germany, or the Netherlands. In any case, those limits should be different, since current restrictions apply only to payments and not to holdings.

With such usage limits, default waterfall systems will have to be explored. The most likely design would be a linked payment account at the commercial bank or PSP level. Extra digital euro units would drop into this account after being converted in real time. Supervised intermediaries in charge of distribution would also be responsible for ensuring an external account is linked to the digital euro wallet to enable such a default waterfall. A reverse waterfall is also being explored. This would be used to automatically convert private money units into CBDC before making a payment if the balance in the digital euro wallet is insufficient (ECB, 2022c).

An alternative to imposing strong holding limits would be to introduce a negative interest rate for holdings over a certain threshold. This would likely have the same effect, but the question of interest-bearing CBDC also depends on the legal framework it is based on. If, for instance, the CBDC were to be assimilated to a digital form of banknotes, it could not bear interest.³⁰

As for any limit, it is also important to raise the question of the strength of the regulator's commitment. If a financial crisis occurs, depending on its magnitude, allowing convertibility between bank deposits and the CBDC could help preserve payment continuity and limit capital outflows. Therefore, it is likely that if the financial system were threatened, limits would be loosened or even removed. An alternative solution might be to introduce emergency mechanisms, such as temporarily removing limits on CBDC holdings coupled with the usual emergency procedures regarding bank runs, allowing crises to be managed without any added regulatory uncertainty. Ultimately, this emphasizes the complexity of applying usage limits.

The future legislation will have to introduce a consistent set of rules regarding the nature, perimeter, monitoring, and control of these usage limits, if not the quantitative limits themselves. It should also establish a clear liability regime for theft, digital piracy, and fraud detection and management (including customer complaints and compensation), particularly between banks and other distributors.

AML/CFT vs Privacy

In the context of financial transactions, the trade-off between privacy and AML/CFT compliance is usually a heated debate. AML regulations push toward more data gathering although this is, by definition, detrimental to privacy. While a CBDC would have to comply with AML/CFT regulation, too much loss of privacy could lead to public reluctance to the adoption of a CBDC. On the other hand, the use of CBDC would have to comply with the General Data Protection Regulation (GDPR).

In this regard, the Financial Action Task Force (FATF) has issued several non-binding recommendations aimed at improving AML/CFT procedures across all markets. Recommendation 16, the so-called "travel rule", is of particular interest for crypto assets – to which it was already extended in June 2022 in the anti-money laundering legislative package (European Parliament, 2022) – and for CBDC as it relates to "wire transfers" (FATF, 2022). The "travel rule" requires all transactions to be identified both on the sender and recipient ends, whatever the payment amount, and would most likely also apply to the digital euro. The "travel rule" does not necessarily mean that transaction information will be supplied to public authorities but that the latter could access this information if needed.

Several solutions have been proposed to address the above-mentioned trade-off. In principle, implementing a layered privacy system similar to that used by the e-yuan in China would be possible: anonymous small transactions but native traceability for transactions above a certain level. In addition, usage limits could be imposed as with cash payments. However, such layered privacy would be more difficult to monitor and control on a cumulative basis if individual multi-holding of wallets and accounts was authorized.

³⁰ Among the current forms of central bank money, bank reserves are interest-bearing while cash is not.

To the extent possible, the Eurosystem wants to minimize its management of user data, although supervised intermediaries in charge will need full information in order to comply with AML/CFT regulations. Only small transactions could be exempt from such validation. In a sense, this is not worse than the current privacy model used by PSPs for commercial bank money transactions, but it is more restrictive in terms of privacy than cash, which is completely anonymous.

A way to tackle this challenging data collection task might be to make a proper electronic digital identity the basis of the CBDC. In Europe, the Commission (2021) proposal to update the European digital identity (eIDAS) Regulation of 2014 introduces the concept of Digital Identity Wallet (DIW) (European Parliament and Council, 2021; European Parliament 2022). The goal is to provide a pan-European identification wallet that could be used by any European citizen to share specific data with selected public or private institutions. As envisioned by the eIDAS, digital identity would help financial institutions meet their legal obligation in terms of KYC and AML/CFT regulations. However, even though it is technically feasible, the eIDAS does not favor decentralized identity but rather a form of central registry, which does not eliminate the risk of data leaks. Since digital identity could be decisive regarding the implementation of a CBDC, the timelines for creating a DIW and for a CBDC should be aligned so that the CBDC will be able to take full advantage of the features afforded by digital identity.

Beyond AML/CFT checks and data collection by intermediaries, the extent to which the Eurosystem would have access to and maintain individual or aggregated and anonymous data in a single registry will have to be carefully designed in the future legislation. This is paramount for considerations of both security (avoiding the vulnerability of a centralized point of entry) and public liberties (avoiding the perception of a “Big Brother” ECB having access to every citizen’s payment data).

Overall, there are proposed solutions for dealing with this data privacy trade-off, but they always come back to the fundamental conflict between two general interests of legislative nature: individual liberties linked to privacy and AML/CFT linked to identification. Although technical solutions exist, such as zero-knowledge proofs, the issue remains challenging.

Conclusion

The global digitalization of finance has recently put pressure on central banks to issue a digital version of central bank money, a CBDC. After the current investigation phase, the ECB will decide in the fall of 2023 on whether to begin implementation of a European retail CBDC. Although the picture is getting clearer over time, there are still several issues and decisions to be made regarding the future design of the digital euro. This paper has strived to summarize them, while also making recommendations and contributing to the retail CBDC debate in Europe.

A CBDC, as a form of public money, has an inherently democratic aspect. The challenge for the ECB is to design a form of electronic money that would appeal to Europeans while complying with existing regulations like AML/CFT, all this without destabilizing the financial system. On the one hand, for the end users, the CBDC will be in direct competition with stablecoins and other PSPs as a medium of exchange. On the other hand, because it is new central bank money, its impact on the financial system will be completely different from that of bank deposits, and will also differ from one bank to another, depending on their balance sheet structures. One of the main risks is that of “over-adoption”, which would reduce the stable resources of commercial banks, thereby

potentially increasing their financing costs, and ultimately having an impact on their credit activity. Commercial banks have expressed such concern, and the ECB has proposed setting usage limits (in terms of total holdings, per transaction, and daily payments, or through interest rate incentives) to prevent potentially high outflows from banks.

An important issue highlighted in this paper is that of the business model. The ECB is solely responsible for issuing central bank money, and thus also a CBDC, but it is likely that distribution and account management would be left to commercial banks and PSPs. Whether or not the CBDC would have legal tender status, the clear objective of the ECB is to provide it at no additional cost to customers, the same way merchants cannot use price to discriminate between cash payments and card payments. If commercial banks are asked to handle distribution, they should be allowed to cover the associated costs and have the correct incentives. This raises the question of interchange fees and of how fees would compare to electronic payments in commercial bank money. This will be a critical aspect of the adoption of a European CBDC, and principles for sound and fair compensation should be clearly provided by the future legislation.

This paper has also explored issues related to the legal aspects of CBDC. Legal challenges are not only associated with the actual issuance of a new form of money but also include data protection and potential usage limits. While transaction caps also exist for legal cash payments, the legal basis for limits on holdings is less obvious. Such limits would be associated with waterfall and reverse waterfall mechanisms linked to payment accounts, which also raises some technical implementation issues, since it would require some degree of interoperability. Beyond implementation issues, usage limits also raise the more fundamental issue of adoption.

Finally, an important consideration is that of digital identity. While a CBDC could theoretically be implemented without digital identity, leveraging the design of the future DIW has the potential to make the CBDC more efficient. The same thing could also be said of stablecoins. Currently both the CBDC and the eIDAS timelines are running independently but close to each other; both should be made fully consistent in order to make full use of the features supported by the future DIW.

We emphasize here several potential scenarios regarding the retail digital euro project in terms of adoption and relation to crypto regulation. Regarding adoption, there are 4 potential scenarios: 1) the ECB does not launch the digital euro project, 2) the ECB launches the digital euro project and it succeeds on paper but is used only marginally, 3) the ECB launches the digital euro and it is broadly successful, 4) the ECB launches the digital euro, there is a financial crisis, and everyone rushes to get CBDC.

In scenario 1, there is no profound change, but the ECB has indeed initiated a useful discussion on the nature of central bank money and whether it should evolve to a digital format. In scenario 2, understanding the causes and consequences of the limited adoption will be important for assessing whether there was a problem with the implementation or whether there was no real broad use for a CBDC. One major difference is obviously that in scenario 2 the central bank and distributors would have paid the implementation cost, which could be substantially higher than just the research cost. Consequently, the loss of credibility could be higher for the ECB in scenario 2. In scenario 3, the success would be large, commercial bank deposits could shrink and the banking system would have to thoroughly adapt to a new environment and possibly change its transformation model. Commercial banks would probably need some time to adapt and be part of the payment system while continuing to fund the economy under new and potentially degraded financing conditions. Under scenario 4, the shift to

CBDC would be complete and runs on banks that are less solid would trigger cascading defaults. The usual response to bank runs is to reassure the public on the convertibility of commercial bank money to central bank money and to provide lending of last resort to banks. However, combining potentially unlimited support to banks would conflict with the “no bail-out” principle and restricted access to central bank money for the public.

The second sequence of scenarios – to be articulated with the CBDC scenarios – relates to crypto regulation. We also raise 4 potential scenarios here: A) a form of status quo, that is crypto assets including stablecoins are not banned, but issuers of certain types of stablecoins are highly regulated, B) strengthening regulation and even fully banning stablecoins, C) competition between stablecoins and other crypto assets and the CBDC, and D) full integration in the sense that CBDC becomes fully interoperable with stablecoins and potential interbank tokens through open protocols.

In scenario A, the current state of regulation is maintained and the differences in risk between a stablecoin and a CBDC are clear so that stablecoins retain the role they currently play, i.e. an appendix to the markets in DeFi, until the issuance of a wholesale CBDC makes them obsolete. In scenario B, if a full ban on stablecoins is issued, it would eliminate one of CBDC’s potential competitors, and should therefore facilitate the adoption of a CBDC, but to the detriment of innovation and decentralized ecosystems. Retail payments are not the only use case of stablecoins, so a full ban of stablecoins would also have important consequences for the crypto markets as a whole. Scenario C reflects the possibility that public authorities would try to enhance the competition between crypto assets like stablecoins and CBDC, with, for example, increasing regulation, albeit regulation not designed to ban stablecoins but rather to help them develop under good conditions, enhancing consumer protection. Such competition would have important consequences in terms of the design choices for the CBDC. Knowing it will compete with general purpose stablecoins, the CBDC should contain important features like programmability, possibly leading to scenarios 3 or 4 described above. Otherwise, it would have to find a niche, for instance, fostering financial inclusion in those parts of the euro area where it is lagging, which would de facto lead to scenario 2. Finally, in scenario D CBDC would be fully interoperable with other crypto asset protocols, including stablecoins. This would likely increase adoption since many services could be tied to such an ecosystem. This could also theoretically support financial stability, since capital could flow in and out of the financial system more easily, thereby limiting liquidity fragmentation.

Overall, although a significant number of design choices must still be made, actual uses of a CBDC are still far from clear. The true difference with other forms of digital money is the counterparty, i.e. the central bank and the general public may not perceive this as being an important characteristic for a retail digital currency. Regardless of whether a retail CBDC in Europe will prove useful, raising the question of the nature of money is already positive per se. Whether this version of the digital euro is implemented or not, those questions and their answers will remain.

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Working group composition

Chair:

François-Régis Benois

Rapporteur:

Louis Bertucci

Members :

Michel Bilger

Michel Cojean

Bernard Descreux

Christian Pfister

Continuez la discussion en envoyant en mail à l'adresse : contact@aefr.eu