

The Digital Euro Project. A Preliminary Assessment

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“The Eurosystem has no commercial interest in user data or behaviour.

*A digital euro could therefore help to safeguard
what has always been the essence of money: trust”.*

Dr. Jens Weidmann, former President of the Deutsche Bundesbank

Abstract: *The decrease in physical cash usage, the excessive market power of BigTech companies, the largely unregulated market of crypto assets which poses risks to financial stability, as well as the need for more financial inclusion and for lower-cost cross-border payments are just as many arguments in favour of a central bank digital currency (CBDC). However, there are as many points urging caution. In this context, the purpose of the present paper is to analyse the specificity of the potential digital euro as part of the international payments’ architecture. The European Central Bank (ECB) is focusing on the digital euro project, running the investigation phase until October 2023. The debate on the digital euro adoption is in line with the international one, but there are several distinctive aspects. Various scenarios are taken into account, starting from general principles for retail CBDCs, results of the public consultation of a digital euro, experts’ opinions regarding privacy, security, usability, costs, offline use, acceptance, potential disintermediation, standards and international implications of the digital euro. The research also outlines the relations between major actors involved, while identifying the prerequisites for a swift functioning of the Eurozone payment system with digital euro at its core.*

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Introduction

Money and payments have continuously evolved, reaching new dimensions in the last years (Panetta, 2022). At present the catalysts of the changing global landscape for payments are the multitude of new actors, innovations and payment solutions, stimulated by and at the same time stimulating consumers’ preferences for digital instruments and online shopping (Panetta, 2021a; 2021b).

The key private sector innovations relate to the crypto assets market and the activities of the BigTech companies. Boar, Holden and Wadsworth (2020) remark that crypto currencies “remain a niche means of payment”. By contrast, BigTech

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companies² systemic footprint in the financial system is a reality, in contrast to other non-bank payment service providers (PSP), such as FinTechs. Their large-scale access to personalized information reinforces their benefits from network effects. The “data-network-activities” loop – or the “DNA” loop – enables them to multiply data extracted from social networks and e-commerce platforms extremely rapidly once the critical mass of users is formed. This DNA circuit offers BigTechs considerable advantages in terms of market power concentration and data management. New payment solutions fit perfectly with the consumers’ needs but there is the risk of excessive concentration of economic and informational power in the hands of a few actors, especially digital platforms (Ehrentraud et al., 2021; FSB, 2019a and 2019b; FSB, 2020; Carstens et al., 2021; Adrian, 2021; Crisanto, Ehrentraud and Fabian, 2021; Crisanto and Ehrentraud, 2021; Restoy, 2021).

To mitigate the risks previously mentioned, to safeguard the monetary and financial stability, and to take full advantage of opportunities associated to CBDC adoption, central banks embarked on a journey of investigating the opportunities and risks associated to the “general purpose” central bank digital currency. This means considering trusted digital money as a public good complementary to cash, that can be used by the public, therefore not restricted to wholesale, financial market payments (BIS, 2020).

Around 100 central banks have been exploring the possibility of launching their own CBDCs (Georgieva, 2022). On a particular note, Sweden was one of the first countries to assess this need, by starting the e-krona project in 2017³. This pilot project is based on a Distributed Ledger Technology (DLT) – a blockchain technology. Only the Sveriges Riksbank can create e-kronas, which are then distributed to the general public through intermediaries such as banks and payment service providers (Urbinati et al., 2021). On a general note, most of these projects are in the research phase and more than ten of them have updated to the testing phase (pilot projects in China, Canada, France, Russia, Saudi Arabia, South Africa, South Korea, Sweden, United Arab Emirates, but also Jamaica, Ghana, Uruguay, and the eight island economies under the monetary authority of the Eastern Caribbean Central Bank⁴). Bahamas and Nigeria have already digital currencies. Several countries experienced short-lived trials on CBDC, including Finland and Ecuador (CBDC Tracker, 2022).

In contrast to crypto assets such as Bitcoin, which are privately issued, the central bank electronic money, either wholesale or retail⁵, would be free of liquidity risk, credit risk and market risk, resembling cash (House of Lords of the United Kingdom,

² In the category of non-bank payment service providers, from which the five giants are distinguished under the new acronym MAMAA: Meta - former Facebook -, Apple, Microsoft, Amazon, and Google’s parent company Alphabet. The BigTech business model is based on direct user interactions and data generated as a by-product (but with an essential role) of these interactions. Knowing consumer preferences offers BigTech companies the opportunity to offer personalized services to customers insufficiently served by traditional creditors.

³ On the Sweden’s central bank official home page can be consulted the e-krona reports and testing status: <https://www.riksbank.se/en-gb/payments-cash/e-krona/difference-between-e-krona-and-crypto-assets/>.

⁴ Anguilla, Antigua and Barbuda, Commonwealth of Dominica, Grenada, Montserrat, St Kitts and Nevis, Saint Lucia, and St Vincent and the Grenadines.

⁵ Retail CBDCs facilitate payments involving households, small or medium-sized enterprises, while wholesale CBDCs facilitate payments between financial institutions. The most viable retail system is considered the hybrid one (indirect or two-tier), meaning that the central bank maintains a central ledger which records CBDC balances and processes payments, while financial institutions such as commercial banks manage customer account services. The direct retail system assumes that all data and transactions are managed by the central bank (House of Lords of the United Kingdom, 2022; BIS, 2021a).

2022; Weidmann, 2021). A CBDC would be issued by a central bank but the supporting infrastructure would involve both public and private participants (The White House, 2022).

The mission of monetary authorities in the CBDC adoption process can be made easier by learning from past lessons concerning previous CBDC projects. At the same time, the guidance and principles outlined by international organizations, as well as researches by various central banks offer already helpful lines of action. The success of a digital euro project will be determined by its adoption by the end users, as well as the wide participation of the financial industry and, in particular, of the PSPs, who, being directly in touch with customers, can encourage or not the usage of the digital euro (Urbinati et al., 2021). Furthermore, it should be noted that any new digital payment method will need to offer compelling advantages over current options or novel benefits that simplify daily life (ECB, 2022).

In this context, the research question of this paper is whether the adoption of the digital euro is opportune, based on a detailed investigation of its pros and cons.

Digital euro definition starting from general characteristics of a CBDC

According to the Committee on Payments and Market Infrastructures (CPMI), “a CBDC is a digital form of central bank money that is different from balances in traditional reserve or settlement accounts”. CBDC is a new form of central bank money, i.e., a central bank liability, but new only for general purpose users, as central banks “already provide digital money in the form of reserves or settlement account balances held by commercial banks and certain other financial institutions at the central bank” (CPMI-MC, 2018). CBDC is fiat currency issued by central banks in digital form (Allen et al., 2020). It is “an electronic form of central bank money that could be used by households and businesses to make payments and store value” (Bank of England, 2020).

CBDC is “a widely accessible digital form of fiat money that could be legal tender” (Mancini-Griffoli et al., 2019). As fiat money, CBDC would keep its three functions: a unit of account, a means of payment, and a store of value.

The best option for creating CBDCs suggested by Adrian and Mancini-Griffoli (2019) is that based on a public-private partnership (PPP), called synthetic CBDC (sCBDC). PSPs would act as intermediaries between the central bank and the end users. Therefore, as long as the end user does not hold a claim on the central bank, these liabilities would not be a CBDC and are instead a form of “narrow-bank” money (BIS, 2021a).

There are two main types of CBDCs: wholesale used by financial institutions, and retail (general purpose), used by consumers and businesses. There are two retail alternatives: (1) digital token currency, circulating in a decentralized way without a central ledger, allowing users to execute transactions anonymously and (2) deposit accounts with the central bank, requiring digital identification to access (Bindseil, 2020). Traceability of transactions is needed to comply with the AML-CTF rules: anti-money laundering and counter-terrorist financing.

The CBDC requires an **appropriate infrastructure** (Bank of England, 2020), which includes a **functional, economic and technological design**. Responsibilities and tasks between the central bank and the private sector should be shared in a two-tier system, public and private, ensuring a balanced functionality of the system, meeting the users’ needs (Banque de France, 2021).

Some authors show preference for the minimal central bank's intervention in operational activities related to CBDC. In their opinion, the private sector actors should be responsible with all the operating activities related to regulatory compliance, wallets, underlying technology, settlement platform, customer data, transactions, customer requests, complaints and questions. In this way, the central bank avoids cyber risks and reputational risks, as well as burdensome costs, stimulates further financial competition, innovation and intermediation and offers trust, efficiency and stability (Adrian and Mancini-Griffoli, 2019).

There are **various design choices** for a CBDC, according to: access (wide versus restricted; direct access when the central bank is the sole provider of payment services or intermediated access, when third parties distribute the digital currency; unlimited or capped; available to non-residents or not); degree of anonymity (ranging from complete to none); connectivity requirement (online and offline); interest bearing characteristics (yes or no); technology/ledger types (token- or account-based; distributed ledger technology DLT, centrally controlled infrastructure or other technologies), degree of disintermediation (low if CBDC is a basic functional layer, while existing non-governmental financial institutions interface manage a second layer that interfaces with users, high if the implication of the central bank is larger) (CPMI and Markets Committee, 2018; Auer and Böhme, 2020; Allen et al., 2020; Urbinati et al., 2021). Some of the issues that need a close monitoring address the CBDC impact on: competition, monetary and financial stability, payment system, monetary policy transmissions and implementation, financial intermediation, cross-border transfers.

Digital euro

At a time when the interest in CBDCs is increasing and the process of assessing benefits and risks accompanying the digitalization of the fiat money is at its height, the European Central Bank (ECB) is focusing on its own **digital euro project**. In July 2021, the ECB decided to launch an investigation phase for the possible introduction of a digital euro attractive to consumers. The investigation phase related to the design, distribution and use of the digital euro was opened in October 2021 and will last for two years, until October 2023. The earliest date for launching the digital euro would be 2025, if decided to adopt it.

The digital euro has to be: convertible at par, a liability of the Eurosystem, a European solution, market-neutral and trusted by end users (Urbinati et al., 2021).

The ECB is cooperating with other six central banks (Bank of Canada, Bank of England, Bank of Japan, the Federal Reserve, Sveriges Riksbank, and the Swiss National Bank) and the Bank for International Settlements (BIS) on CBDC. Four reports have been published until now (BIS 2020; BIS 2021b, 2021c, 2021d). Their takeaways are the following:

1. Foundational Principles and Core Features.
2. System Design and Interoperability.
3. User Needs and Adoption.
4. Financial Stability Implications.

Fabio Panetta, the Chair of the High-Level Task Force on a digital euro has described most eloquently the key role of the future digital euro. Cash represents the only form of central bank money citizens hold. As the demand for cash is decreasing due to

the acceleration of digital payments, cash seen as a payments anchor might lose its core role. To prevent that, the digital euro is considered the appropriate substitute (Panetta, 2021a). Various scenarios are taken into account, as an orderly adjustment of the financial sector is needed. Either of the two extremes should be avoided: a too successful or an unsuccessful digital euro (Panetta, 2021b).

The digital euro is intended to be a trusted, general purpose fiat currency issued by the Eurosystem (the ECB and national central banks) in digital form, which would complement cash and would accomplish the functions of fiat money: a unit of account, a means of payment, and a store of value. It has to be “riskless, accessible, and efficient” (ECB, 2021a).

Fabio Panetta, Chair of the Eurosystem High-Level Task Force on Central Bank Digital Currency (HLTF-CBDC) defines the digital euro, its potential functions and benefits as follows (Panetta, 2021a; 2021b; 2021c; 2021d):

- Electronic money issued by the central bank, designed as a digital means of payment that is attractive to consumers.
- A way to ensure that central bank money remains at the core of the financial system.
- A reflection of the fulfilment of the central bank’s key task, namely money creation, thus accomplishing “public interest objectives such as inflation control and the cyclical stabilisation of the economy”.
- A form of digital money that provides “a low-cost, efficient means of payment that is available everywhere” and protects users’ privacy.
- A digital currency meeting the needs of consumers and companies, but avoiding any potential risks and preventing illicit activities (consequently, payments in digital euro have to be traceable, in order to avoid illicit transactions, such as those related to money laundering, the financing of terrorism or tax evasion).
- A central bank liability, free of any risk, be it market risk, credit risk, or liquidity risk.
- A “simple, safe and reliable” form of sovereign money, a “monetary anchor” provided by the ECB in electronic format.
- A means to offer households, businesses, commercial outlets access to a payment instrument that is secure, cost-free, easy to use and universally accepted within the euro area.
- A complement to cash, not its replacement.
- A way to promote stability and financial inclusion.
- A digital currency with a value guaranteed by the state, in contrast with the crypto-assets defined as “a bet, a speculative high-risk contract with no supporting fundamentals” and no “socially or economically useful functions” (a means of payment with a highly fluctuating value which prevents them from performing two of the three functions of a currency: store of value and unit of account).
- Through the interoperability with private payment solutions, it would “level the playing field by making it possible for all market participants – bank and non-bank intermediaries and fintechs – to offer, at a lower cost, products that allow people to pay instantly”.

- A catalyst for cross-border payments, by ensuring interoperability with foreign digital currencies.
- A means of strengthening Europe's financial sovereignty and international role of the Euro.

The digital euro project should be analyzed in close connection with the larger European framework related to digital finance and retail payments. The Digital Finance Package of 24 September 2020 (including the “Digital Finance Strategy for the EU” and the renewed “Retail Payments Strategy for the EU”) is the most significant (European Commission, 2020a and 2020b). Looking at the priorities/pillars of these Strategies (Box 1), one can remark that they pave the way for the eventual digital euro adoption. In its turn, the digital euro would support the implementation of these Strategies.

Box 1: Priorities of the Digital Finance Strategy and the Retail Payments Strategy for the EU

The priorities for the digital transformation of the European financial sector are: (1) to tackle fragmentation in the Digital Single Market for financial services, thereby enabling European consumers to access cross-border services and help European financial firms' scale up their digital operations; (2) to ensure that the EU regulatory framework facilitates digital innovation (e.g. distributed ledger technology DLT or artificial intelligence AI) in the interest of consumers and market efficiency; (3) to create a European financial data space to promote data-driven innovation, building on the European data strategy, including enhanced access to data and data sharing within the financial sector; (4) to address new challenges and risks associated with the digital transformation, paying particular attention to the principle “same activity, same risk, same rules”.

The Retail Payments Strategy for the EU focuses on the following four key pillars, which are closely interlinked: (1) high-quality digital and instant payment solutions with pan-European reach; (2) innovative and competitive retail payments markets; (3) efficient and interoperable retail payment systems and other support infrastructures; and (4) efficient international payments, including remittances.

Sources: European Commission, 2020a and 2020b.

Arguments in favour of adopting the digital euro, in balance with potential risks

The arguments for adopting the digital euro are numerous, as there are also plentiful against it. In our opinion, a digital euro, if efficiently and safely designed, might reflect further the symbiosis of the public and private initiatives and actions. The state, beyond the tools of regulation and taxation, has also the prerogative to develop the required infrastructure, according to the needs of the general public and the private sector. Actors, technology, means and instruments of payment evolve in parallel with the optimization of the personalized experience of consumers, taking into account the transformations in terms of their consumption habits and their requirements (Capgemini, 2021). Current monetary arrangements implemented by the private sector (especially banks and non-bank financial actors) continue to serve the public well, and retail payments in the Eurozone are becoming faster, cheaper and more efficient.

At the same time, the Eurosystem already contributes to the payments' infrastructure development. For instance, the TARGET Instant Payment Settlement

(TIPS) service was launched by the Eurosystem in November 2018. It was conceived as a multi-currency platform, with the capability to process other currencies as well as the euro (starting with May 2022, TIPS is expected to settle instant payments in Swedish krona, while instant payments in Danish krone could also become available by November 2025, the latest) (ECB, 2021e). It operates on a full cost-recovery and not-for-profit basis and the price per transaction is set at 0.20 cents. The instant payment transactions are completed within a maximum of 10 seconds and the typical execution time (the “latency”) is actually well below the 10 seconds threshold (less than 5 seconds for 99 per cent of the transactions). It enables PSPs to offer fund transfers to their customers in real time and around the clock, every day of the year, on a 24/7/365 basis. TIPS is a public service that does not compete with market solutions, but rather promotes their development by ensuring the interoperability of systems at the pan-European level (Visco, 2020).

British researchers and policy makers summarize the benefits of the CBDC (House of Lords of the United Kingdom, 2022), which are also valid for the digital euro:

- Supporting the central bank’s objectives of maintaining monetary and financial stability.
- Maintaining a resilient payments landscape.
- Avoiding the risks of new forms of private money creation.
- Stimulating competition, efficiency and innovation in payments.
- Meeting future payment needs in a digital economy.
- Improving the availability and usability of central bank money.
- Addressing the consequences of a decline in cash.
- Enabling better cross-border payments.

Referring to the digital euro, the fundamental motivation for its adoption is the need to maintain the role of public money in the digital economy, given the decline in the use of cash and the amplification of the process of digitalization of payments (Brunnermeier and Landau, 2022). Experts wonder what central banks should do if all private money were to become digital, in other words, if only private money will be available to the general public (Brunnermeier and Landau, 2022). There is, of course, a long way to go before this extreme scenario, involving zero cash. But its mere presence in the international debate has led to countless studies on the opportunities and risks that accompany CBDC.

The digital euro would not be only a response to the decline in the role of cash as a means of payment, but it could also: (1) support the digitalisation of the European economy and the strategic independence of the European Union; (2) counteract a potential large-scale presence of a foreign CBDC in the euro area, which could affect capital flows and euro exchange rates; (3) become a new monetary policy transmission channel; (4) mitigate risks to the normal provision of payment services; (5) foster the international role of the euro, and (6) support improvements in the overall costs and ecological footprint of the monetary and payment systems (ECB, 2020).

On the one hand, innovations such as crypto currencies and the “walled garden” ecosystems of BigTechs might work “against the public good element that underpins the payment system” (BIS, 2021a). On the other hand, cash use in payments is decreasing and it seems that a key function of the central banks, namely providing cash for public use, loses its importance (BIS, 2020). Besides, in spite of the development of the international system of payments, there are still “unmet user needs” which could be fulfilled by CBDC

adoption (BIS, 2021b). Finally, CBDC has the potential to offer new opportunities for innovation (BIS, 2021c).

Panetta (2021b) points out that non-EU payment providers already handle around 70% of European card payment transactions, and that if these providers' footprint continues to grow, it would raise serious questions about Europe's payment autonomy, with potential implications for users. At the same time, the use of cryptocurrencies (including stablecoins) is growing, and large technology companies (BigTech) have considerable advantages in terms of their market power and data management capacity, being of systemic importance (Panetta, 2021b).

Being aware of this context, Panetta (2021a) considers that the digital euro should ensure the European monetary, political, and financial sovereignty. The European level-playing field and sovereignty are at risk if one takes into account the following factors: the total value of crypto-assets, especially stablecoins is increasing, the digital retail payment system is dominated by foreign operators and several foreign Big Tech companies have acquired a significant economic power. A potential removal of traditional intermediaries from the market might lead to higher costs and lower quality of services. The digital euro as a means of payment free, easy to use and available to everyone is beneficial both for the European citizens and companies as well. At the same time, small intermediaries will be able to offer products with a higher technological content at a competitive cost. Therefore, it is evident the role of digital euro as a catalyst for fair competition.

Simon and Schellekens (2021) appreciate that "Fiat digital currencies offer a way to rebalance the asymmetric information economy. A fiat digital currency, as opposed to the current privately created cryptocurrencies, would provide each citizen with their own digital account or wallet that could be used across all digital platforms. This account is expected to record key information for each transaction, the account holder having the sole control of this data – being able to share or not their information as they see fit, levelling the playing field between the digital platforms and their customers. It would also level the playing field between platforms and governments, undercutting the leverage today's corporate behemoths have against the public sector through their control of when and where they pay taxes. Instead, a fiat digital currency could ensure exchange is taxed at the moment of occurrence and in the jurisdiction where the exchange occurs".

On the other hand, the **risks** associated with the adoption of the digital euro are numerous, similar to those associated with the CBDC in general.

Several central banks have published studies that conclude that launching CBDC would turn the central bank into a direct competitor of commercial banks, but without generating more efficient payment alternatives. The core tasks of a central bank are to maintain a secure payment system, to ensure financial stability and price stability through monetary and exchange rate policy. By adopting a CBDC, the central bank would become a retail bank for the private sector, which could jeopardize the stability of the financial system (Danmarks Nationalbank, 2017).

The Bank of International Settlements, in a joint study with other seven central banks (including the ECB), underlines the risk of disintermediating banks or enabling destabilising runs into central bank money, thereby undermining financial stability (BIS, 2020). The study concludes that a central bank should have robust means to mitigate any risks to financial stability before any CBDC is issued (BIS, 2020). Moreover, a "digital dollarisation" could see a national currency substituted by another with the domestic

central bank gradually losing control over monetary matters (BIS, 2020). BIS (2021a) underlines: technical failure, counterfeiting and cyber risks; risks associated with the situation when payment systems fail to interoperate, generating fragmentation and “closed loop systems” that are accompanied by user costs from a lack of competition.

British researchers point to: state surveillance of people’s spending choices (risks to individual privacy); financial instability as people convert bank deposits to CBDC during periods of economic stress; an increase in central bank power without sufficient scrutiny (also through unconventional monetary policy); the creation of a centralised point of failure (namely the centralised CBDC ledger) that would be a target for hostile state and non-state actors (House of Lords of the United Kingdom, 2022). Bossu et al. (2020) analyse legal, financial and reputational risks. Reputational risk is also underlined by Soderberg et al. (2022), in the situation where there is not a wide acceptance and circulation of CBDC.

If the central bank charges intermediaries for using the CBDC system, there is a risk that intermediaries will in turn pass the cost downstream and raise the price of payments, which may counter initial policy goals (Soderberg et al., 2022). Talking about alternative ways to design the CBDC, when it comes to anonymity, it is evident that “the more anonymity, the larger the risk for illicit use” (Soderberg et al., 2022). Besides, “CBDC projects are resource-intensive and become even more so as their scale increases” (Soderberg et al., 2022). “As technology is still developing, choosing the best technology is deemed a challenge” (Soderberg et al., 2022).

The consequences of adopting the digital euro are so significant, that the decisions regarding its fostering must be well-founded. In the specific case of the digital euro, there are at least three particular risks. One is related to the possibility that one or more central banks from the Eurosystem reject the digital euro. Another one is connected to the scale of the project, which is set to be major. Third, the private sector offers enough means of payment which are safe, rapid and reliable. Therefore, the persuasive power of the ECB has to be strong enough to convince all stakeholders to embark upon the digital euro project.

Key elements to be taken into account upon designing the digital euro

In the seminal “Report on a digital euro” (ECB, 2020), a series of characteristics regarding the digital euro were identified. Five of them are considered core principles, eight are scenario-specific requirements and seven are general requirements (Table 1). These are similar to the features and principles envisaged by the BIS (2020) and G7 (2021). The digital euro should stimulate cooperation, knowledge-sharing, innovation and efficiency in services for end users, and it must meet certain conditions, such as “ease of use, low cost, convertibility, instant settlement, continuous availability and a high degree of security, resilience, flexibility and safety” (BIS, 2020).

Table 1. Principles and requirements related to the digital euro

Core principles	P1: Convertibility at par: Not a parallel currency
	P2: Liability of the Eurosystem: A digital euro is central bank money and its issuance is controlled by the Eurosystem
	P3: European solution: Widely accessible on equal terms in all euro area countries through supervised service providers
	P4: Market neutrality: Not to crowd out private solutions
	P5: Trusted by end users: Trusted solution from the start and over time
<p>Scenario-specific requirements, if the digital euro is launched:</p> <p>(1) to support digitalisation; (2) to tackle the decline of the cash demand; (3) as an alternative to other payment solutions; (4) to be a tool of monetary policy transmission; (5) to improve the resilience of the payment system; (6) to increase the international role of the euro; (7) to improve the cost efficiency and (8) to improve the ecological footprint of the current payments' ecosystem.</p>	R1: Enhanced digital efficiency: The digital euro should keep pace with state-of-the-art technology at all times in order to best address the needs of the market as regards, among other attributes, usability, convenience, speed, cost efficiency and programmability. It should be made available through standard interoperable front-end solutions throughout the entire euro area and should be interoperable with private payment solutions.
	R2: Cash-like features: To match the key distinctive features of cash, a digital euro aiming to tackle a decline in the acceptance of cash should permit offline payments. Moreover, a digital euro should be easy for vulnerable groups to use, free of charge for basic use by payers and should protect privacy.
	R3: Competitive features: To provide functionalities at least as attractive as those offered by other payment solutions.
	R4: Monetary policy option: It should be remunerated at interest rates the ECB can modify over time.
	R5: Back-up solution: It should be transacted via resilient channels that can withstand extreme events.
	R6: International use: It should be potentially accessible for non-Eurozone residents, in a way that is consistent with the Eurosystem objectives.
	R7: Cost saving: The design should reduce the cost of the current payments' ecosystem.
	R8: Environmentally friendly: The technological solutions chosen for the digital euro should improve the ecological footprint of the current payments' ecosystem.

General requirements	R9: Avoidance of imbalances: The digital euro should be an attractive means of payment but its use as a form of investment should be discouraged, in order not to generate large shifts from private money to digital euro.
	R10: Stimulus for cooperation with market participants, according to the best practices in IT project management.
	R11: Compliance with the regulatory framework, including standards.
	R12: Safety, efficiency and a judicious division of responsibilities and tasks between the ECB and the private market actors. Non-core services should be left to supervised private entities.
	R13: Easy accessibility throughout the euro area: It should be interoperable with private payment solutions and it should be easily accessible by everyone.
	R14: Conditional use by non-euro area residents, in order to avoid excessively volatile capital flows and exchange rates.
	R15: Cyber resilience: The digital euro should be protected of cyber-attacks and in case of such an attack, the recovery time should be short and the integrity of data protected.

Source: ECB (2020).

Besides these principles, it is important to know **what the general public expects from the digital euro**. In the “public consultation on a digital euro”, run by the European Central Bank (ECB)⁶, both consumers and professionals considered privacy the most important feature of a digital euro (43%), followed by security (18%), usability across the euro area (11%), the absence of additional costs (9%), and offline use (8%) (ECB, 2021d; Weidmann, 2021). Definitely these should be high on the list of the most important design features of a digital euro. According to a more recent study done by the ECB, among the most important features that could underpin the adoption of a new payment method are mentioned the following: its universal acceptance; instant, contactless and open person-to-person payments; a one-stop solution; easy to use, secure, reliable and fast; cost-efficiency (ECB, 2022).

Beyond the pros and cons of adopting a CBDC, the success or failure of this new form of digital currency is ultimately determined by the degree of trust that users will have in it (Fugaru, 2021). The widespread acceptance of the digital euro is crucial. The user trust in the currency starts with its security. This means, on the one hand, a secure platform for transactions, which prevents fraud and, on the other hand, the security of

⁶ The public consultation was launched on October 12, 2020 and closed on January 12, 2021. A number of 8.221 respondents submitted their answers. Germany accounted for 47% of the whole sample, Italy and France for 15% and 11% respectively, five additional countries each provided 1-5% of replies, while all other countries account for less than 1%.

the personally identifiable information. Security breaches may lead not only to the loss of trust in the digital currency, but also to the reputational harm of the central bank (Hansen and Delak, 2022).

As regards privacy, it cannot be tackled without the general EU policy objectives, including here anti-money laundering (AML) and combating the financing of terrorism (CFT). Ensuring confidentiality is doable, but not the anonymity, as traceability of transactions is a precondition for AML and CFT.

At the same time, previous CBDCs experiences reveal lessons worth being taken into consideration. Grym (2020) regards the Avant smart card system created by the Bank of Finland in the 1990s as the world's first CBDC, a token-based retail CBDC. Avant cards incorporated smart card technology similar to nowadays debit and credit cards. It was a low-value, pre-funded anonymous e-money payment instrument, where monetary value was stored on the card itself and it was expected to replace coins and small denomination banknotes. It complemented debit and credit cards, which were more appropriate for higher value transactions at the time. The system was initiated, developed, and for the first few years, operated by the central bank, but it was eventually sold to commercial banks. In the third operational year, it was decided that the central bank would retain the role of "overseer in the payment system" and "of participating in the development of standards", while "the business of issuing retail payment instruments would be left to commercial actors". After the cost-free period has ended, at a time when costs of using debit cards were decreasing, and their security features were improving, debit cards gained wider acceptance, and Avant was discontinued. The key lesson learnt from this example is that **only payment instruments which are attractive for consumers (competitive as compared to the others) will survive in the competitive market.**

Another example is given by a CBDC in operation between 2014 and 2018. It was called Dinero Electrónico and was based on a mobile platform developed by the central bank of Ecuador. Any mobile phone owner (not necessarily smartphone owners) could transfer money in real-time. The system was not fully backed by USD, but it was fully backed by USD-denominated assets instead. Accounts were initiated and managed by the central bank, were denominated in USD (the official currency in Ecuador) and population could open them by accessing a dial-in protocol, registering the national identity number and answering security questions. The number of users peaked 500,000, very low as compared to the total population of 17 million. In spite of incentives to use Dinero Electrónico, only 10% of the accounts were used to make payments for goods and services, including public services. In the absence of the critical mass of users and amid criticism from private banks considering Dinero Electrónico as a threat to their intermediation activities, the Ecuadorian central bank gave up on its digital currency. The key lesson learnt from the Ecuadorian experience is: **however attractive their design may be, the CBDC initiatives can be successful only if they meet two cumulative conditions: (1) they are intensely publicized, explained and understood and (2) they are supported by all economic actors, including consumers, public institutions and banks** (Arauz, Garratt and Ramos, 2021).

Consequently, the *sine qua non* preconditions for a successful digital euro project are the effective multi-level cooperation and its acceptance by the public. The public authorities have to build upon a strong relationship with key stakeholders (first consumers, but also financial intermediaries, producers, exporters, importers and

merchants). To accomplish its roles, the digital euro will need to be carefully designed. It will have to bring an added value for users, support competition rather than crowd out private innovation, and avoid risks to financial intermediation (Panetta, 2022).

Digital euro experiments

The ECB is the main actor in the digital euro project. The Governing Council of the ECB established in January 2020 the Eurosystem High-Level Task Force on Central Bank Digital Currency (HLTF-CBDC) in order to advance the investigation of the digital euro.

In September 2020 the HLTF-CBDC launched experimental work on the digital euro.

The Directorate Market Infrastructure & Payments (DG-MIP) of the ECB, the Digital Euro Market Advisory Group, the Directorate Market Infrastructure & Payments (DG-MIP) of the ECB and the Euro Retail Payments Board (ERPB) play a significant role in the preparatory stage for the digital euro. A number of 30 senior consultants “with proven experience and a broad understanding of the euro area retail payments market” were hired to provide consultancy services for supporting the digital euro project investigation phase. The newly formed Market Advisory Group for the digital euro project has among its tasks the elaboration of proposals for the digital euro concept, business model and technical solution, and promotion of the project with relevant market providers and stakeholders (including international fora, relevant consumer and industry associations, EU institutions, etc.) (ECB, 2021b; ECB, 2021c). The Digital Euro Market Advisory Group advises the Eurosystem on the design and rollout of the digital euro.

During the formal investigation phase which began in October 2021 and is scheduled to end in October 2023, one can remark the increased interactions between the ECB and other European authorities and institutions – the Parliament, the Commission, the Council, the Eurogroup (as the digital euro will require legislative changes) –, as well as those with private stakeholders.

The ECB is currently working together with the technology providers⁷ and banks on the end user features of a digital euro so it could be integrated into the services that they are already offering to their customers. The results of the investigation will be presented to the Governing Council, which will take a decision regarding the digital euro adoption or not (Panetta, 2021d). The general institutional framework of the digital euro project is already established.

According to the European Banking Federation, the ECB should explore together with banks the digital euro design. The primary argument is that European banks have in-depth experience with digital transformation and competences on relevant IT and governance structures such as electronic identification solutions, as well as AML/CTF. Many European banks have specific know-how in already implemented solutions based on DLT, distributed infrastructure and related governance (EBF, 2021).

Considering the *Study on New Digital Payment Methods* (ECB, 2022), it became clear that the ECB has started from the “CBDC Pyramid” (Auer and Böhme, 2020). It analyses the consumer needs that a retail CBDC could address, identifies associated technical design trade-offs, and then drafts the design choices.

The most circulated proposal for the **technological tool** to support the CBDC

⁷ For instance, a European fintech payments dialogue took place on 2 December 2021.

implementation is the distributed ledger technology. It has advantages in terms of availability, low failure potential and integrity of transaction records through cryptographic hashes. But at the same time it has also disadvantages related to security risks due to actions which do not require permission (smart contracts include vulnerabilities). The need for a strong information security program is justified by the various forms of attacks, either phishing and malware to obtain credentials or private keys, or insider unfair practices leading to asset theft, or unintentional technical errors embedded in algorithms, or even espionage against critical infrastructure (Hansen and Delak, 2022).

In the preliminary phase, starting from September 2020, the ECB organised four work streams during which were tested the possibilities of running a digital euro with a centralised system, a decentralised one, a mixture of the two, and with offline payments (ECB, 2021f).

A list of questions has to be answered, starting from:

- How large should be the system?
- How is the access (wide versus restricted; direct access when the Eurosystem is the sole provider of payment services or intermediated access, when third parties distribute the digital euro; unlimited or capped; available to non-residents or not)?
- Is the system centralized or decentralized?
- How is the degree of anonymity (ranging from complete to none)?
- Will payments in digital euro be made online, offline or both options will coexist?
- Will the digital euro bear interest?
- Will the digital euro be token or account-based?

Conclusions

This paper highlighted both the European Central Bank's motivations for adopting a digital euro and the existing obstacles. There are still a number of questions that need to be answered. The digital euro should achieve the appropriate trade-off between expectations of all market actors and the objectives of the Eurosystem. The mission of the ECB in the process of adopting the digital euro is facilitated by the lessons learned from previous projects. At the same time, the guidelines and principles outlined by international organizations, as well as the research of the various central banks and institutions, provide useful directions for action.

There are various options for the digital euro, starting with: access level (widespread or restricted, limited or unlimited, available to non-residents or not), anonymity, technology (distributed ledger technology, centralized technology or other technologies), degree of disintermediation (depending on the degree of involvement of the ECB). Probably the ECB will take into account the two-tier approach, with a minimal central bank's intervention in operational activities related to the digital euro. As underlined by the literature, it is the best way to avoid cyber risks and reputational risks, as well as burdensome costs. Moreover, it stimulates further financial competition, innovation and intermediation and offers trust, efficiency and stability.

However, taking into account that the adoption of the digital euro, similar to other CBDCs, is accompanied by potential opportunities and risks, any decision has to be well-founded. When foreseeable risks are overwhelming in relation to predictable

benefits or when the general support of the population and of private payment providers for the digital euro is not clear, it is preferable to abstain from adopting it. Instead, it might be recommendable to solve current problems in other ways, for instance by a stricter regulation of the activity of some economic actors, especially those of systemic importance.

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