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Envisioning a digitalised currency: the role of a Digital Euro and its consequences

1. Introduction

Do we really need a Central Bank Digital Currency (CBDC)? Is there a market failure or a reasonable justification that allows the central bank to introduce a CBDC? Is a CBDC feasible, and how should it be implemented? Should it pay interest, or should it be as cash-like as possible? What would the implications be following its introduction? These are the questions currently debated in the financial and economic literature on Central Bank Digital Currencies.

The rising interest of the general public in crypto-currencies and the consequential regulative efforts show interest in crypto-currencies not only by the public but also by central banks around the world (Barontini & Holden, 2019). Major European Institutions, including the European Commission (European Commission, 2023), the European Parliament, and the European Central Bank (European Central Bank, 2023), showed interest in the topic of CBDC.

As of December 2024, the share of payments made with cash keeps decreasing in the Euro area, and the share of payments made via non-cash media (cards, mobile apps) keeps increasing (European Central Bank, 2024). Also, the share of consumers who prefer non-cash media keeps increasing. This signals a growing interest of the general public in non-cash media, and by non-introducing a non-cash medium of payment, the central bank would, as time goes by, lose its sovereignty over money (Cipollone, 2024).

The sitting governor of the ECB, Christine Lagarde, in October 2024, commented on CBDCs and the digital Euro, confirming the interest of the ECB in introducing a CBDC by the end of 2025, provided a legal definition by the European Parliament based on technological and economic considerations. Lagarde offered two key reasons for a digital Euro:

- "Everything is digital, and central bank money should be digital as well" (Lagarde, 2024), arguing that we must digitalise the Euro to maintain trust and sovereignty in currency.
- "Payment systems are not sovereign and very fragmented" (Lagarde, 2024), admitting that a digital Euro would bring the European Union closer, facilitating peer-to-peer and point-of-sale transactions between people and traders in a cheap, fast, and transparent manner.

Thus, this paper aims to piece together different opinions and schools of thought on CBDC, with a particular focus on the Eurozone. It attempts to collect various definitions of CBDC, explore the different possible implementations, its feasibility, and the new monetary policy tools that will arise with the adoption of a CBDC, and delve into the reasons for its implementation and the risks associated.

However, I find that, the question of a digital Euro extends beyond purely economic considerations. As digitalisation advances and private monies proliferate, political, legal, and social dimensions of a CBDC must be thoroughly explored. A legal framework and a defined political vision are needed to develop economic analysis further. Given the potential for profound shifts in the financial landscape, European authorities must take the lead in defining the objectives and scope of a CBDC, allowing economists to provide a more informed advice on the future of digital central bank money.

2. What are Central Bank Digital Currencies?

The literature offers various perspectives when defining a CBDC, but the fundamental idea is widely shared. The core idea is “digital central bank liability”. From this starting point, different concepts are attached to the definition of CBDC.

Paolo Fegatelli, Banque centrale du Luxembourg, 2024, adds to the standard concept of CBDC its complementarity to cash, defining CBDC as “central bank liability offered in digital form to citizens and business for their retail payments, complementing the existence of cash and wholesale central bank deposits” (Fegatelli, 2024).

Ben Fung, Bank of Canada, 2018, defines CBDCs as “central bank liabilities, widely available to the general public which can be used to make payments” (Gnan & Masciandaro, 2018, p. 15).

Bjorn Segendorf, Sveriges Riksbank, 2018, defines CBDC as “central bank liability, denominated in national currency, available 24/7, more broadly accessible than current central bank deposits” (Gnan & Masciandaro, 2018, p. 19). Given the declining use of cash, citizens will have fewer and fewer access to central bank money.

Santiago Fernandez De Lis, BBVA Research, 2018, highlights the technological dimension, describing CBDC as “central bank issued instruments combining cryptography and digital ledger technology to achieve four goals: improved inter-bank settlement, improved payment system efficiency, improved monetary policy effectiveness through overcoming the zero lower bound on nominal interest rates, and stronger surveillance and better financial system stability” (Gnan & Masciandaro, 2018, p. 12).

Fabio Panetta, Banca d’Italia, 2023, comments on a digital Euro remarking on its need, adding to its standard definition the strict requirement for privacy, thus presenting it as cash-like as possible: “A digital euro would be a digital form of cash that could be used for all digital payments throughout the euro area, free of charge, both online and offline. It would offer the highest level of privacy by default and allow users to settle payments instantly in central bank money. It could be used for person-to-person (P2P), point-of-sale, e-commerce and government payments. No existing digital payment instrument offers all these features.” (Panetta, 2023).

The core idea of CBDC has been defined similarly to the idea defining cash as "a central bank liability", suggesting the interest in establishing CBDC as cash-like as possible. However, the definition and implementation of CBDC are strongly intertwined, shaping each other depending on the desired outcome, which is still unclear. Are CBDCs meant to replace cash, or should they function as a third form of central bank money?

In the Euro area context, the European Commission and the ECB unquestionably intend to consider a digital Euro as a complementary tool to cash, thus not substituting cash but implementing a safer alternative to private means of payment (e.g. cryptocurrencies) for digital transactions (European Central Bank, 2023).

3. The definition-implementation dilemma

As previously stated, the definition and implementation of CBDCs are strongly interdependent concepts. To better understand what a digital Euro could be, it is important to delve into the various possible implementation paths offered by the literature that could ultimately define it.

No matter how a digital Euro is implemented, the ECB will change the digital transactions market, which is now entirely operated by private entities.

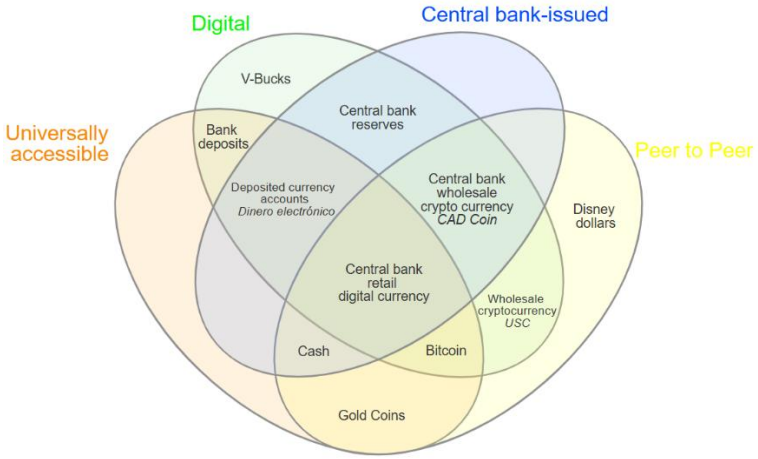
An analysis of the disruption to the free market caused by the introduction of a digital Euro, based on its implementation, is conducted by Peter Bofinger and Thomas Haas. The implementation of a CBDC can be discussed from two different perspectives (Bofinger & Haas, 2020, p. 2):

- CBDC, intended as a new payment object for the retail public, would put the ECB in a competitive position with commercial banks' deposit accounts.
- CBDC, intended as new payment systems operated by central banks, implying competition with providers of payment systems

		New payment object	
		No	Yes
New payment system	No	Status quo	New payment object used in current payment systems
	Yes	Central bank digital payment systems	New payment system in which new payment object is used

From Table 1, when implementing a digital Euro purely as a new payment object, commercial bank's deposit account and thus bank's business model would face the competition of the central bank. On the other hand, a digital Euro implemented as a new payment system would result in the central bank competing with payment system providers, a market in which a strong oligopoly exists, which may be seen as a market failure.

Another characteristic of a digital Euro that must be discussed when considering its implementation is whether it should be wholesale (accessibility limited to specific institutions or groups) or retail (universally accessible). Within this debate, it is interesting to consider the money flower, in Figure 1, by the Bank for International Settlements (Bech & Garratt, 2017, p. 61).



The image describes the main characteristics that must be discussed when implementing a CBDC, giving relevant examples.

Another feature of a digital Euro discussed in the literature is whether it should bear interest or not and if it should bear fees. This feature will be discussed in section 3 of this paper, along with the relevant monetary policy tools that would arise. For the moment, let us introduce the four implementation scenarios envisaged in the literature by Santiago Fernandez De Lis, BBVA Research (Gnan & Masciandaro, 2018, pp. 12-13):

1. A wholesale non-interest-bearing CBDC might be implemented for interbank settlement. This would improve wholesale money market efficiency, and reducing barriers to entry would open the participation of third-party providers. An experimental example of this is CADcoin, a proof-of-concept DLT-based wholesale payment system (Bech & Garratt, 2017, p. 61).
2. A non-interest-bearing CBDC with retail access and anonymity might replace physical cash at a lower cost and higher efficiency, improving retail payment efficiency. Depending on whether the CBDC is implemented as token or account-based, having an account with the central bank might need to be made obligatory. As a result, bank deposits and credit might fall. Overall, it would be convenient for end-users. Given anonymity, the informal economy might be encouraged.
3. An interest-bearing CBDC with universal access and anonymity would appear to help central banks overcome the zero lower bound on interest rates. The authorities would also need to abolish physical cash to make the negative interest rates work. Due to the far-reaching impact of financial repression and the fiscal nature of negative interest rates on CBDC, the frontiers between monetary and fiscal policy would be blurred, raising questions of central bank legitimacy and ultimately threatening central bank independence.
4. A non-interest-bearing CBDC with retail access and full identification (account-based CBDC) would make the central bank a deposit-taking institution, thus competing with commercial banks, increasing surveillance on the public, and reducing financial system instability. This approach might sharply reduce bank credit unless the central bank redirects funds to the financial systems, reducing the bank's business model to narrow banking and disrupting the current banking system. The very far-reaching nature of this form of CBDC would again raise issues of central bank legitimacy.

From these four scenarios, we understand that when implementing a CBDC, it must be discussed whether it should be implemented on a token or an account basis (Bofinger & Haas, 2020, p. 6).

A token-based CBDC can be exchanged on a peer-to-peer basis and thus be as cash-like as possible, not requiring a bank account neither with the central bank nor with commercial banks, guaranteeing anonymity to the user, but also facilitating money laundering and the financing of terrorism, which would conflict with the Unions' regulations. On the other hand, if transactions were to be traced, such as in the e-krona, it is not very likely that there would be a large demand for such token-based CBDCs. Still, a token-based CBDC would strongly resemble a prepaid card(e-money) and thus should be subject to the same AML/CFT regulations.

An account-based CBDC, is based on an account held at the central bank, and can be regarded as a fully-fledged bank account with the central bank, making it a deposit-taking institution and putting it in a competing position with commercial banks. In this scenario, the central bank should also create a new payment system that the central bank operates. Otherwise, the CBDC would result in another payment object used in the already established payment

systems, thus preventing the central bank from gaining sovereignty over payment systems(Bofinger & Haas, 2020). The creation of millions of private bank accounts by central banks would pose an enormous administrative challenge, the feasibility and ECB's intentions will be discussed in section 6.

It is hard to identify an apparent market failure that would justify the entrance of the central bank, a public entity, as a competitor for commercial banks; even if the CBDC were to be implemented as a wholesale account-based CBDC, it would be hard to identify a market failure in how today large firms and investors settle payments at the national and international level(Bofinger & Haas, 2020).

Regarding the implementation of an account CBDC, we can further differentiate whether it can be used only as a store of value or universally (both for payments and for store of value).

In the scenario where the CBDC is implemented only as a safe store of value, it will offer the absolute safety of banknotes in a digital version, a role previously covered only by banknotes. Citizens would only be allowed to transfer money from the central bank account to the commercial bank account. This implementation scenario may further accelerate digital bank runs during a banking crisis. (Bofinger & Haas, 2020). This paper, in section 8, will further explore what the literature says about the risk of digital bank runs regarding CBDCs.

A store-of-value CBDC could be limited to wholesale use, addressing specific needs for larger deposits above €100,000 that are not protected under national deposit insurance schemes. This would make store-of-value CBDCs attractive to larger investors and firms, serving as safe assets to substitute, for example, government bonds. However, their remuneration rates would need to be zero or negative, ensuring they do not offer better returns than standard bank deposits to avoid favouring large investors over average households(Bofinger & Haas, 2020).

Additionally, payment service providers could use wholesale store-of-value CBDCs as collateral for their depositors (e.g., stablecoins). Unlike bank deposits and government bonds, which face stability risks during crises, CBDCs as collateral would provide greater security. A related concept is synthetic CBDCs (sCBDCs), where private banks or payment providers back deposits with central bank reserves, allowing customers to indirectly hold CBDCs. This approach, already practised in China, could help central banks retain control over payment systems by requiring payment providers to maintain 100% reserves in central bank money.

To schematise the relationship between wholesale/retail and the token/account-based implementation, refer to the table 2:

		Retail	Wholesale
Token based		e-money	---
Account based	Universal	All-purpose CBDCs	All-purpose CBDCs
	Store-of-value only ('safe assets')	Store-of-value CBDCs	Synthetic CBDCs

When implementing a CBDC, policymakers must also decide whether CBDC should be freely convertible into other forms of central bank liabilities (i.e. reserves and cash) and commercial bank deposits (Meaning et al., 2021). Traditionally, central banks allow these

forms of money to be exchanged at par (1:1), which ensures monetary stability. This approach allows central banks to control the overall size of the monetary base, leaving its determination to public and banking preferences.

However, some authors (Kimball & Agarwal, 2015) (Casemaker & Krogstrup,2018) propose a departure from this tradition, especially for CBDCs, and suggest a flexible exchange rate between cash and CBDC to enforce negative interest rates on cash. This would create two separate fiat currencies in the economy, raising concerns about the unit of account.

Additionally, it is standard practice for commercial bank deposits to be convertible into central bank money at par; maintaining this convertibility is seen as essential for preserving confidence in bank deposits. Many central bank actions, such as lender of last resort and deposit insurance, are designed to ensure this convertibility and maintain a stable monetary system. Therefore, ensuring CBDCs and bank deposits coexist and are exchanged at par is considered critical for stability (Meaning et al., 2021).

Still, the most significant debate in the literature remains whether a digital Euro should pay interest, at what rate, and which new monetary policy tools would appear with the introduction of interest-bearing or non-interest-bearing CBDC.

4. Should a digital Euro pay interest?

As stated in the introduction, European Institutions have the interest in introducing a digital Euro in complementarity with cash without interfering with bank funding and intermediation; for this reason, it is proposed the digital Euro should not pay interest analogously to cash; the ECB observes that this should not affect its capacity to reverse this decision in the future, to maintain remuneration control of all the liabilities on its balance sheet.

Depending on the scope and implementation, a digital Euro could heavily interfere with monetary policy transmission; introducing an additional large-scale central bank liability requires adopting new tools to fine-tune its circulating volume (Fegatelli, 2024).

Two instruments envisaged by central banks (European Central Bank, 2020) to control CBDC volumes are:

- “hard limits” on CBDC holding, i.e. ceiling on CBDC holding that could be enforced by refusing to settle the transaction or by rerouting the excess amount to a commercial bank account
- rate of remuneration on CBDC, intended as interest payments and charges or fees.

Let us consider Paolo Fegatelli's analysis in the case of a retail digital Euro traded at par with other central bank liabilities (i.e. cash). A digital Euro could be non-interest-bearing or interest-bearing (paying positive/zero/negative rates).

Under no-arbitrage conditions, the literature (Meaning et al., 2021) shows that the equilibrium remuneration rate for CBDC (R^C) would be equal to the risk-free rate (R) minus the transactional utility premium of CBDC (ϕ^C): $R^C = R - \phi^C$, with all other interest rates in the economy equal to $R^x = R^C + \phi^x$ where ϕ^x is equal to the risk premium for asset x. Fegatelli highlights that regardless of using a CBDC as a monetary tool, its existence would anchor the whole structure of the interest rates in the economy (Fegatelli, 2024, p. 5).

To understand the impact of a remuneration rate for CBDC, Fegatelli proceeds with three assumptions to build a working scenario (Fegatelli, 2024, p. 6).:

> H1) The central bank continues to implement monetary policy via interest rates without compromising transmission via the bank lending channel, without modifying its monetary policy stance nor implementation framework (i.e. central bank "business" is "conducted as usual").
>
> H2) The central bank wants to preserve the neutrality principle between different payment means.
>
> H3) The central bank wants to preserve its independence.

Given these assumptions, Fegatelli considers three remuneration scenarios:

- Non-interest-bearing (cash-like)
- Interest bearing as (one of) the main policy rate(s)
- Non-interest bearing but with variable-rate deposit fee

Let us consider a non-interest-bearing digital Euro; the central bank would maintain the status quo when conducting monetary policy (Fegatelli, 2024). This scenario presents us with two severe drawbacks:

- If the central bank were to impose a negative interest rate on excess reserves, banks have the incentive to shift from holding reserves to CBDC, an objective more complex to achieve with cash. Consequently, the effective lower bound would be raised to zero (Bordo & Levin, 2017).
- Public demand for CBDC would counteract the central bank's adjustments to interest rates(Meaning et al., 2021). Increasing policy rates would widen the gap between bank deposit rates and the zero remuneration of CBDC. This would encourage people to shift funds from CBDC to bank deposits, increasing funds for bank lending and loosening credit conditions—opposite to the policymaker's intent. Conversely, lowering policy rates would reduce the spread, prompting a shift from bank deposits to CBDC and reducing funds available for lending or reserves. Both scenarios undermine the central bank's policy objectives.

Still, in my view, implementing a non-interest-bearing digital Euro would align more coherently with the goal expressed by European authorities (Lagarde, 2024) (Panetta, 2023) of keeping a CBDC as close as possible to cash. In contrast, an interest-bearing CBDC could involve the application of negative rates (Xin & Jiang, 2023), which might cause a shift from CBDC holdings to cash. Furthermore, if a CBDC were to replace cash and negative rates became necessary, questions of constitutionality may arise, as some European Union member states, at least formally, protect savings in their constitutions (e.g. Italy art. 47, Portugal art. 101).

The literature recommends an interest-bearing CBDC on the drawbacks of a non-interest-bearing digital Euro (Fegatelli, 2024). With an interest-bearing CBDC, the whole economy would be anchored to its rate. Thanks to universal access and CBDCs' "riskless" feature, Fegatelli recognises that in this scenario, a digital Euro would directly compete with bank deposits, especially overnight deposits.

Per se, introducing a CBDC would disrupt the banking business model (Bofinger & Haas, 2020). With an interest-bearing CBDC, banks would face further competition from the central bank (a public institution), which may configure as a deposit-taking institution, a "nationalised bank" or "monobank". In my view resembling the banking model advocated by Vladimir Lenin (Garvy, 1977, p. 21), thus disrupting how, at the status quo, credit is provided and allocated to the economy. This disruption of free competition and the entrance of a public competitor in the banking industry may collide with the funding values of the European Union(art. 119 par. 1 TFEU, art. 3 par. 3 TEU).

Following Fegatelli's analysis, in this scenario, banks would have to pay a higher rate (R^D) on deposits, given that deposits are not riskless as the CBDC: $R^D = R^C + \phi^d$, where ϕ^d represents a risk premium on deposits. This implies that following an increase in CBDC rates, commercial banks would have to further increase deposit rates.

Fegatelli identifies two key outcomes from this scenario:

- given direct control of the CBDC rate by the policymakers, the central bank could immediately influence the cost and availability of bank funding, strengthening monetary policy transmission.
- a retail interest-bearing CBDC without holding limits may compromise the two-tier structure of modern financial systems.

Meaning et al.(2021) suggest a synchronisation of the CBDC with other policy rates to avoid a shift between bank deposits and CBDC holdings to reduce banking distress. This result may be achieved by differentiating the rate between bank and non-bank or by keeping the bank's CBDC holding and bank reserves as two separate assets, each paying its rate, with the rate paid on reserves slightly higher than the CBDC rate, justifying this "rate-discrimination" by the key role and function played by banks in monetary policy transmission and economy in general. Also, in this scenario, a sudden run from deposits to CBDC holding may be managed smoothly (Fegatelli, 2024).

I am of the view that, this "rate-discrimination" policy may be a reasonable solution. However, given that one in two adults in the European Union lacks a sufficient understanding of basic financial concepts (OECD, 2020), this policy may be perceived negatively by the general public. It could be viewed as an attempt by the central bank to favour financial institutions or increase bank profits.

In the last scenario a significant problem arises, it may conflict with H1, to ensure monetary policy transmission CBDC net remuneration, should remain within a narrow range, because of the existence of other private monies that impose a floor on deeply negative rates (Fegatelli, 2024) and monetary policy transmission under deeply negative rates might become somewhat uncertain.

Thus, the third scenario proposed by Fegatelli is a non-interest bearing but with a variable-rate deposit fee. Because of private monies, there exists a lower boundary for the CBDC rate. However, an upper boundary on CBDC remuneration may also exist. H2 implies that the central bank must preserve its neutrality on the payment media chosen by the public. An interest-bearing digital euro would serve two primary roles: as a risk-free asset and as a medium of payment. This dual nature makes it a close substitute for bank deposits, physical cash (e.g., banknotes and coins), and e-cash. Compared to cash, the digital Euro would likely offer greater transactional utility, influenced by its design, legal limits (e.g., instant payments

and transfer caps), lower theft risks, and reduced safekeeping costs. From Fegatelli's analysis and assumption of the coexistence of cash, CBDC and deposits, at equilibrium, the rate paid by the CBDC should never be greater than the policy rate; thus $R^{C\text{-}Eq} = \phi^{B\text{-}Eq} - \phi^{C\text{-}Eq} = R - \phi^{C\text{-}Eq} \leq R$, from the identity we get that CBDC remuneration should equal the difference between transactional utilities of cash and CBDC without ever exciding the policy rate.

Under normal circumstances, this would mean that CBDC should not pay a positive rate; otherwise, people would be incentivised to switch between cash and CBDC: as the CBDC nominal rate of return follows the main policy rate, any upward (downward) move of the policy rate would imply a higher (lower) total expected return for CBDC over cash, influencing the public preference between the two (Fegatelli, 2024), thus breaching H2.

An upper boundary also exists in relation to H3, given that a CBDC would appear in the central bank balance sheet as a liability; a positive rate on CBDC would require the central bank to invest the same amount in assets, paying at least the same rate(Fegatelli, 2024). This would require the central bank to increase its holding of securities, and the possibility of asset-side losses cannot be excluded, thus interfering with central bank independence. This increased purchase of safe assets by the central bank may interfere with the normal functioning of market economies and credit allocation, and the central bank may configure as a lender of last resort for governments, conflicting with H3 of this model, but furthermore with art. 123 TFEU.

Furthermore in my opinion an interest-bearing central bank liability may undermine central bank independence by creating pressures to engage in quasi-automatic monetary expansion to meet interest obligations. This could, in effect, result in what might be perceived as 'mandatory quantitative easing,' potentially compromising the central bank's control over its balance sheet and its ability to prioritize price stability or other policy objectives.

The introduction of an upper boundary allows us to portray R^C in the following identity:

$LB(U_{CC}) < R^C \leq \min(0, R)$ where the lower boundary is a function of the utility of private monies, and the upper boundary is the minimum between zero(the return on cash) and the main policy rate (Fegatelli, 2024).

This slightly negative interest rate could be implemented as a variable deposit fee, which could be justified by the operational and maintenance costs borne by the central bank or by third parties for the CBDC infrastructure (Fegatelli, 2024). I believe that recalling the OECD survey on financial literacy, the general public may not fully understand this deposit fee. For instance, the question, 'Why should I pay a deposit fee on CBDC for operational costs when I do not pay any fees for using cash?' may arise, reflecting a common misconception. While it is clear to us that the cost of cash—covering printing, handling, transportation, and security—is indirectly borne by society as a whole, cash may be seen as free by the average adult, thus reducing the demand for CBDC.

Following Fegatelli, only the CBDC deposit fees would be anchored to the main policy rates while the CBDC nominal rate would remain constant at zero.

In a negative-rate scenario, this system would be like the proposal of Meaning et al., for positive policy rates, the CBDC would become a zero-interest asset like cash. However, once the policy rate significantly exceeds the CBDC rate, we would have the risk of funds shifting from CBDC to bank deposits or back, depending on the direction of change in the policy rate,

with all the related implications for banks' liquidity management and financial stability (Fegatelli, 2024).

To my understanding, a recurring challenge that the literature tries to circumvent is the coexistence of cash and CBDCs. But what if we were to fully replace cash with a digital euro? While this approach may not align with the positions of European Institutions, it could also threat financial inclusion for vulnerable groups in our society, such as the elderly.

This issue highlights an inherent contradiction. On one hand, cash usage is steadily declining (European Central Bank, 2024), with an increasing preference for digital payment methods. On the other hand, under the current trajectory, vulnerable populations may encounter difficulties managing home-banking accounts, potentially facing similar challenges with a CBDC account depending on its implementation.

This prompts a critical question: should the digitalisation of currency be left to the private sector, or should central banks offer a secure alternative? While the coexistence of CBDC and cash introduces considerable costs and complexity, replacing cash with a CBDC might present fewer long-term challenges at the cost of a radical change in the short term, provided its implementation adequately addresses issues of accessibility and inclusion. The cost and complexity of implementing a CBDC in coexistence with cash must be further evaluated against the disadvantages of implementing a CBDC in substituting cash.

Still, the position of the European Institution of complementary between cash and CBDC is clear. Thus, we should consider which new monetary policy tools the central bank would have following the introduction of a digital Euro.

5. Changes in the monetary policy toolkit with a CBDC

The literature shows that after the introduction of a CBDC, new monetary policy tools may arise, and the effectiveness of existing ones may be enhanced. A digital Euro may also allow policies that do not necessarily require a CBDC to be implemented, but the existence of a CBDC may affect their feasibility and impact(Meaning et al., 2021).

Firstly, as Fegatelli highlighted, reserve requirements(RR) would be "dusted off" and regained importance in the monetary policy toolkit.

The central bank could raise (lower) the RR on bank deposits when an increase in the policy rate raises (reduces) the differential with the CBDC rate to offset an excessive increase (decrease) in the public's supply of bank deposits while pushing the bank deposit rate back towards its previous level (Fegatelli, 2024).

In positive rate circumstances, if the central bank were not to follow the previously defined constraint ($LB(U_{CC}) < R^C \leq \min(0, R)$) and were to anchor the CBDC rate to (one) the main policy rate(s), a positive gap between the remuneration of CBDC and physical cash would arise, thus leading to an abandonment of cash, conflicting with H2. On the other hand, following the previously defined constraint, the CBDC would become a zero-interest asset for positive rates. Thus, funds may shift between bank deposits and CBDC, following the direction of change in the policy rate, undermining financial stability and the conduct of monetary policy (Fegatelli, 2024).

To address this effect, RR could serve as a complementary measure. Specifically, when an increase in the policy rate widens the gap between the bank deposit rate and the CBDC

remuneration (fixed at its upper limit), the central bank could raise the RR to counteract the rise in bank deposits and nudge the bank deposit rate back toward its prior level. Similarly, when a reduction in policy rates narrows the spread with the CBDC remuneration, the central bank could lower the RR to mitigate a potential decrease in bank deposits (Fegatelli, 2024). Fegatelli defines the new role of RR as an “emergency brake” to control the shifts between commercial bank deposits and CBDC under exceptional circumstances.

Another monetary policy instrument that could be easily implemented with the creation of a CBDC is "helicopter money" (Friedman, 1969) or the direct distribution of newly created money by the central bank to the public. Given the effective lower bound on interest rates, central banks have engaged in quantitative easing following the 2007-2008 financial crisis, where the central bank purchases financial assets, typically government bonds, directly from market participants. CBDC could support quantitative easing by directly transferring central bank funds to individuals and firms – so-called "helicopter money" – to stimulate aggregate demand. Thus, when the effectiveness of Quantitative Easing(QE) is limited, the use of direct transfers of CBDC may be helpful to the central bank. Some authors argue that QE, when conducted with newly printed money, does not generate significant direct benefits for low-income households in the short run but only in the medium term; in contrast to QE, helicopter money could be able to generate an immediate increase in households’ wealth. (Temperini et al., 2024).

Temperini's analysis shows that issuing a CBDC has the potential to create a new transmission channel for monetary policy. However, its effectiveness depends on behavioural patterns and on different propagation mechanisms than those usually activated by monetary or fiscal policy.

Transfers may be targeted to households or firms' accounts, depending on the desired outcome. Temperini et al. suggest that fiscal transfers might have the highest immediate impact on GDP, but their effectiveness crucially depends on how quickly the CBDC would be spent.

However, “helicopter money” could be done without CBDC, although such methods might have higher administrative costs(Gnan & Masciandaro, 2018, p.62).

On the contrary, if the central bank were to use Quantitative Tightening(QT) to reduce the monetary base with a CBDC, it could simply forcefully withdraw from the CBDC accounts.

Instead of forcefully withdrawing from accounts, if the CBDC were to be implemented as interest-bearing, as mentioned previously, the central bank could implement a negative interest rate policy (NIRP). In theory, NIRP can stimulate the economy, stabilise the exchange rate and achieve the desired level of inflation after a crisis; as found by Xin B. and Jiang K, NIRP is feasible with a CBDC. CBDCs eliminate the zero lower bound constraint and effectively stabilise the economic fluctuations caused by a NIRP, the central bank can implement a NIRP by directly adjusting the interest rate of digital currency to accelerate macroeconomic recovery. However, we must remember that only de iure a CBDC can help to overcome the ZLB, de facto the existence of cash, stablecoins, and other forms of private monies poses a limitation on deeply negative rates, thus the elimination of physical cash and or restrictions on its use, and restrictions on the use of private monies might be required to ensure an effective application of negative rates, these limitations may be perceived as liberticidal and discriminatory by the general public.

Introducing a CBDC may enhance the existing monetary policy tools and improve monetary policy transmission; a CBDC that is universally accessible, interest-bearing, and freely convertible could strengthen the monetary transmission mechanism (Meaning et al., 2021). This is primarily because interest rates across the economy would become more sensitive to changes in the central bank's policy rate.

The existence of a competitive alternative to bank deposits through CBDC is likely to mean that if the interest rate on that alternative changes but deposit rates do not move by an equal amount, then people will reallocate their portfolios. This would create flows between the two assets. If the policy rate paid on CBDC is increased, then this could result in a fall in demand for bank deposits, with a subsequent increase in deposit rates. At the same time, if the policy rate is cut, this could drive demand from CBDC into bank deposits, causing a decreasing in deposit rates. A CBDC is likely to strengthen the transmission of changes in policy rates, increasing the speed and extent of the monetary policy pass-through (Meaning et al., 2021).

A CBDC might amplify the real interest rate and cash flow channels. This would happen because interest rates on savings and credit would shift more for the same change in the policy rate, and so would the incentives for intertemporal substitution by economic agents. However, if a CBDC becomes a close substitute for bank deposits, and particularly if it leads to a significant reduction in the size of bank balance sheets, it could reduce the importance of the bank lending channel, thus reducing the bank's role as intermediaries in monetary policy transmission(Meaning et al., 2021).

As highlighted by Fegatelli and Meaning et al., a CBDC has the potential to enhance the effectiveness of QE. It would allow the central bank to purchase assets directly from non-banks, paying by crediting their CBDC accounts. This approach to QE would not depend on the reaction of the banking sector and would mean that there would be no impact on bank balance sheets. This would weaken the effect of QE through the bank lending channel. However, the central bank could still conduct asset purchases directly with the banking sector.

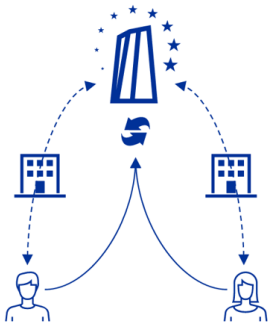
6. Is a digital Euro feasible?

From a technological point of view, it is still unclear whether a CBDC should use distributed ledger technology(DLT) or more established technologies, such as those currently used for existing central bank real-time gross settlement systems(such as TARGET T2). Importantly, this highlights a distinction between a central bank digital currency, which can be based on various technological options, and a central bank cryptocurrency, which is based on cryptographic technology (Meaning et al., 2021). DLT would allow for greater resilience because of its decentralised nature, but it is considered too immature to power a critical national payment system.

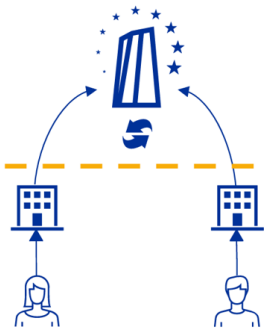
From the report on a digital Euro(ECB, 2020), the central bank highlights the importance of its retention of control of the back-end infrastructure of a digital euro. Two approaches are considered for the back-end infrastructure: centralised and decentralised. In the first approach, digital euro transactions are recorded in the Eurosystem’s ledger. In the decentralised approach, the Eurosystem sets rules, and private entities function as custodians of digital euro holdings, thereby leaving users with a claim on the intermediary rather than on the Eurosystem. The ECB clearly states that all claims should be on the Eurosystem, thus excluding the possibility of a fully decentralised back-end.

The ECB recognises it would face technical and organisational challenges when implementing a centralised CBDC. It would need to process a volume of payments that its current infrastructure is not designed to handle. The two most feasible access models, shown in Figure 2, are envisaged:

- direct, in this model, the end-user would interface with the ECB to manage their holding of CBDC; de facto the central bank would be running one account per citizen. The ECB recognises that it would be technologically challenging for the Eurosystem to operate the number of connections and independent accounts to be provided, and for which the present central bank IT infrastructure is not designed, direct access would imply a significant operational burden for the central bank.
- intermediated, Eurosystem could continue interacting directly only with supervised intermediaries, which would act as settlement agents instructing transactions on behalf of their customers. This scenario seems to be the most feasible at the moment from an IT and operational perspective.



Direct access



Intermediated access

Yet the report is almost four years old, and a clear position on the ECB's payment processing capabilities is missing. Thus, to further understand the practical feasibility of a CBDC, a precise evaluation of ECB's infrastructural capabilities and more IT considerations are needed.

7. Reasons for a CBDC

Now that we have explored what a CBDC could be, and several implementation scenarios, we should further explore why we should deviate from the status quo and introduce a CBDC.

A CBDC available to the public would complement central bank reserves and banknotes (the two existing forms of public money), with wider access than the former, currently held almost exclusively by banks, and a digital form unlike the latter, and provide a digital monetary anchor for private money. A CBDC would help ensure the integrity of digital payments, promote financial inclusion, and act as a catalyst for innovation in finance and commerce more broadly.

The most prominent reason for the issuance of a CBDC is the fast ascent of digital private monies(cryptocurrency and stablecoins); in this sense, a digital Euro would make it possible to counteract the risk of loss of monetary sovereignty (understood as the ability to respond to the needs of the people). The need for digital means of payment by the people is clear (European Central Bank, 2024); to this need, a democratically legitimated legal tender must

be offered by the central bank. Otherwise, there's the risk of losing monetary sovereignty. As explored in Section 5, a digital Euro would also enhance monetary policy transmission, so by introducing a CBDC, the central bank not only would gain back the terrain lost to private monies but would also strengthen its position.

Fabio Panetta, in his speech “The cost of not issuing a digital euro," highlights several reasons for the creation of a digital Euro; a digital euro is justified as a modern extension of central banks’ historic role in providing reliable, publicly accessible means of payment that underpin financial stability. With the dominance of international players in the digital payment market, Europe risks losing its autonomy and competition in financial services. The rise of tech platforms like PayPal, Ant Financial, Amazon, Apple Pay, and X, with their forays into financial intermediation and private digital payment instruments, poses threats to privacy, monetary sovereignty, and the stability of payment systems. A digital euro would counterbalance these trends by offering a secure, pan-European public alternative that ensures privacy, promotes competition, and prevents over-reliance on private entities. Its offline payment capabilities could enhance privacy further by eliminating third-party validation. Designed to complement existing financial systems, the digital Euro would preserve monetary stability while fostering a more resilient and inclusive payment landscape.

As the governor of the ECB highlighted, a digital Euro would be pivotal to preserving citizens’ trust in money and payment systems in the digital Age; Lagarde then states that the current hybrid model(central banks supply cash and reserves, and the private sector relies on it to provide the bulk of total money for payments, and citizens can always trade at par private monies for public money) is threatened.

This model is threatened by the decreasing usage of cash, resulting in public money ultimately losing its role as the monetary anchor for the hybrid model. Secondly, the emergence of new kinds of digital assets could foster instability and confusion among citizens about what is money and what is not; the emergence of stablecoins, suitable for payments but vulnerable to runs - and often not backed at all, could further destabilise the status quo. Thirdly, the entry of big techs into payments could increase the risk of market domination and dependence on foreign payment technologies.

Issuing a digital euro would indeed safeguard people's confidence that "one euro is one euro", allowing them to convert private digital money at par into digital central bank money (Lagarde, 2022).

Furthermore, given that public's access to high powered money is a *condicio sine qua non* for the existence and meaning of the central bank, the issuance of a CBDC would ensure that the public has access to high powered money. At the status quo, the access is granted by cash, but considering its rapid decrease in use, and its narrow availability, a digital Euro would ensure broader access of citizens to high powered money in every scenario. Thus, by issuing a CBDC the central bank would grant a broader access to high powered money and maintain sovereignty, by fostering the trust that people have in the institution.

In my view, the strongest reason for introducing a digital Euro lies in the nature of fiat currency itself. Fiat currencies are a social pact established to serve society's needs. As society evolves, especially with increasing digitalisation, this pact must evolve to remain relevant and serve its purpose. Failing to do so risks the rise of private, undemocratically legitimised alternatives that could undermine the established democratic order.

8. Risks of a digital Euro

Given the strong interest in implementing a digital Euro, the risks connected to each scenario are to be assessed depending on its implementation path. In this section, the main risks connected to a CBDC will be discussed.

To my understanding, “the elephant in the room” in the CBDC discussion is the trade-off between privacy and AML/CFT compliance. Christine Lagarde commented on this: "We should at least provide a level of privacy equal to that of current electronic payment solutions” (Lagarde, 2022), thus implying not full anonymity, while Fabio Panetta, referring to the implementation of a digital Euro stated “it would offer the highest level of privacy”, thus referring to it as cash-like. If a CBDC were to be implemented as centralised account-based, serious privacy concerns may arise. It would be natural to envisage an Orwellian dystopia, and the demand for such CBDC may be limited in principle (Bofinger & Haas, 2020). On the other hand, if a CBDC were to be token-based, the central bank could be accused of favouring, by removing the obstacles posed by cash, the activities it tries to fight (money laundering and financing of terrorism). On this matter, further political and legal analysis are needed to further develop economic considerations that are connected to the implementation scenarios. Lagarde admits that to protect privacy, “[a] digital euro could replicate some cash-like features and enable greater privacy for low value - low-risk payments, including for offline payments." from a pragmatic approach, it is not clear how this could be implemented.

In my view, privacy-related risks are a critical consideration for legislators when assessing CBDC. These risks must be addressed in order to design and implement an effective framework and advance the broader economic discourse on CBDC. Much of the economic impact hinges on whether the CBDC adopts an account-based or token-based model, which directly influences its degree of 'cash-likeness'.

Another risk that might be seen when envisaging a CBDC is the fact that its introduction may speed up and increase the risk of bank runs. As if today digital bank runs were not possible. Panetta addresses this issue: “It is important to remember that depositors do not need digital central bank money to run from a bank. […] In fact, CBDCs could even help mitigate run risks. A digital euro could provide real-time information on outflows of bank deposits," allowing for a quick institutional response to restore depositors' confidence. In Ben Fung's view, the risk for digital bank runs is not increased by a CBDC; depositors can, in any case, already now transfer money to other, safer banks or buy government securities (Gnan & Masciandaro, 2018, p. 16).

Another risk connected with a CBDC, and especially with an interest-bearing one, is the associated lower supply of deposits, which could cause banking distress and disintermediation, thus a lower supply of credit to the real sector. Several solutions have been proposed by literature, such as “rate discrimination" between banks and non-banks or a "two-tiered remuneration system" (Bindseil, 2020).

The risks for the banking sector, are strictly related to the implementation of the CBDC, and every scenario poses different risks for the banking sector. Overall if an interest bearing CBDC is introduced, and no specific measures to “protect” the fragile maturity transformation business model of banks are put in place; banks risk to dies thus reducing the provision of credit to the economy, in this scenario, the central bank may start to provide credit to the economy, resulting in the abovementioned “monobank” scenario. Bank may also increase risk

taking to stay profitable in face of a deposit supply shortage, thus exposing the economy to the risk of crisis. Banks may also change their business model, towards narrow banking (Gnan & Masciandaro, 2018) with the associated risks of interrupting implementation of monetary policy, threaten the repo market, and by reducing their leverage would thereby threaten general financial stability, and welfare reduction.

The banking disintermediation risks remain an open issue, which depends on the implementation scenario chosen by policymakers.

9. Conclusions

The body of economic literature on CBDC is vast and comprehensive, covering a wide range of scenarios and exploring numerous alternatives. However, to better understand a digital Euro's economic effects and macroeconomic implications, it is now crucial to complement this research with political, legal, and social studies. A robust legal definition and a clear political framework, informed by the existing economic literature, are essential to refine further economic considerations.

It is time for European authorities to articulate a clear and democratically grounded vision of a digital Euro. They must outline the intended objectives, delineate its purpose, and provide a transparent path forward. Such clarity will empower economists and researchers to focus their analyses and provide the most informed and effective advice. Economists alone cannot settle this multifaceted issue; it is time for their work to be projected in the broader context of societal and political priorities.

As digitalisation advances inexorably, democratic legitimated political authorities must step forward to define critical boundaries for CBDC implementation. They need to determine the extent of acceptable trade-offs between privacy and oversight, the limits to which individual freedoms may be undermined, and the circumstances under which market interventions might be necessary. Furthermore, they must assess how much disruption to the free market is tolerable and the extent of power that the central bank can justifiably gain over market operations. Without these foundational principles, it will be challenging for economists and other experts to provide the most apt feedback.

Economists can continue their studies, but it is difficult to arrive at precise answers without a well-defined ideological framework. By 'ideological framework,' I mean a structure encompassing legal, social, economic, and philosophical dimensions. Economists have done their part. However, given the rapid proliferation of private money, the abovementioned spheres must act fast. In the modern era, few things grant greater power than the strength of one's currency.

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