

The Digital Euro
Benefits, Costs and Risks

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1 Introduction

With the digital euro project, the European Central Bank aims to create an „*anchor of stability for the payment and monetary systems*“ (ECB, 2022e) that „*would also strengthen the monetary sovereignty of the euro area and foster competition and efficiency in the European payment sector*“ (ECB, 2022e). In our report, we examine whether these goals can be achieved. In particular, we address the "business case" of the digital euro for citizens, the retail sector and the financial sector and determine what costs are associated with the new system. We analyze from a regulatory perspective how the ECB's relationship with commercial banks would change. We also discuss the risks arising from the digital euro for the stability of the financial system. Additionally, we examine whether there is an alternative that could be achieved with less effort and that would promote competition and efficiency in European payment traffic.

In section 2, we first take a general look at the **structure and functional mechanisms of payment systems**, whose function is always to establish communication between the payer and the recipient of the payment. For the digital euro, it becomes clear that it requires the creation of parallel structures. On the one hand, a communication system is needed to establish a link between the digital euro accounts managed by the commercial banks when purchases are made. On the other hand, the digital euro requires a parallel settlement system for the processing of payments, which must be operated by the ECB in addition to the TARGET system.

In section 3, we try to identify the **advantages of the digital euro** for the private sector. For the digital euro in the online version, traditional bank accounts serve as a basis for comparison. The key difference between the two assets is that the digital euro is central bank money, whereas a bank deposit is only a claim on central bank money. For most bank customers, this differentiation is irrelevant, as this entitlement is guaranteed to them by the deposit insurance for balances up to 100,000 euros. From a cost perspective, digital euro accounts have the advantage that they are to be provided free of charge. However, since a traditional bank account is usually required to hold a digital euro, this advantage is unlikely to play a decisive role. In terms of anonymity, there is no difference between the two assets. Whether a payment system based on the digital euro offers advantages over the status quo is difficult to assess at present, as the ECB wants to leave the establishment of a communication system for the digital euro to private payment service providers. It is not unlikely that this task, which involves high investment and system costs, will be taken over by the U.S. payment platforms that already dominate the market.

In the offline version, the digital euro competes with cash. It thereby shares some of the disadvantages of cash (e.g., risk of loss and theft). Despite efforts by the ECB to ensure a certain degree of anonymity for the offline version, the scope for this is very limited by regulations to prevent

money laundering and anti-terrorist financing. Focus group interviews show that the interest in using digital euros in a "digital wallet" is extremely limited.

In section 4, we look at the **costs of the digital euro**. The creation and maintenance of two parallel systems (communication system between customers and merchants, settlement system between digital euro accounts) gives rise to additional fixed costs and ongoing costs that have to be borne by the participants. Increasing costs could only be avoided if there were monopoly or oligopoly profits in the current system due to insufficient competition, which could be reduced by more competition in a digital euro system. However, there are no signs of such a development.

Since digital euro accounts are to be made available to private households free of charge, the costs of opening and maintaining the account will be borne by the banks. Retailers should bear the costs of payment service providers. Since they are to be forced to accept payments in digital euros, the fees for payment service providers are to be regulated. The Commission goes so far as to say that, if necessary, they should not even be reimbursed for their running costs plus a moderate profit margin. This is all the more problematic as the payment service providers are supposed to pass on a portion of this fee to the account-holding banks ("issuers"). Under these conditions, it is questionable whether the ECB will even find such a service provider for its digital euro.

Banks are not only burdened with the costs of opening and maintaining an account. When their customers withdraw deposits to a digital euro account, their deposit base is reduced. Econometric studies by the European Commission (Bellia and Calès, 2023; Petracco Giudici and Di Girolamo, 2023) show that, depending on the magnitude of the deductions, there may be a **noticeable decline in banks' return on equity**, which would particularly affect smaller and medium-sized banks. In our own analysis, we estimated the effects of deposit deductions by determining the interest costs resulting from the loss of low-interest demand deposits and the need to draw down interest-bearing central bank reserves or take up interest-bearing central bank loans. In our baseline scenario, in which we assume that all households build up a balance of 3,000€, the negative effect for banks would amount to between 1.35% and 1.62% of their capital per year.

Even if it is not possible for the banks to charge these costs directly to consumers, they would be confronted with them in an indirect way. The negative effects for the banks would ultimately be reflected in **higher borrowing costs for the economy**.

In section 5, we highlight the implications of the digital euro for the relationship between commercial banks and the ECB from a **regulatory perspective**. By opening accounts for consumers, the ECB enters into direct competition with commercial banks. Of particular concern is that these

accounts are to be offered free of charge, i.e. at a price that cannot cover costs. The banks are thus forced into ruinous competition with themselves.

From a regulatory point of view, it is irritating that the upper limit for the holding of digital euros, which is essential for the relationship between the central banks and the commercial banks, is not listed in the Commission's regulatory proposal as a mandatory but as an optional provision. It would therefore be at the discretion of the ECB to create a dominant position for itself in the European banking system by setting a high upper limit or eliminating it.

According to most economists, such far-reaching interventions in the market presuppose that a "**market failure**" is identified. But even Fabio Panetta, who was previously responsible for the digital euro on the ECB's Executive Board, stated that no problems were discernible in the European payment ecosystem that could justify the need for a digital euro. For this reason, the ECB is now making a macroeconomic argument. The digital euro is needed as a "**monetary anchor**" for the stability of the financial system. The ECB points out that deposits at commercial banks must be convertible into central bank money. But if this argument is taken seriously, the ECB would have to allow unlimited convertibility. Convertibility limited to a comparatively small amount could therefore not take this argument into account. It can also be shown that what matters for the ECB's control over the money and credit creation process in the euro area is not the central bank balances of nonbanks but those of banks. As long as it is possible for the ECB to bind banks to itself through the instrument of minimum reserves, it would always retain control over the banking system even in a cashless world. If central banks want to ensure that their state currency is not replaced by private currencies, it is essential that they secure the stability of their money. A digital euro could contribute little to this.

In section 6, we analyze the **risks** that the digital euro may pose to the stability of the financial system. Without a cap, the digital euro could prove to be a destabilizing factor. The collapse of the Silicon Valley Bank has shown the dynamics that a digital bank-run can unleash. But even with a cap, there are risks. In principle, the existence of a parallel payment object provided by the central bank can lead to doubts about the quality of the payment object provided by banks, even if it is absolutely safe due to deposit insurance. In general, it will probably be very difficult for the ECB to explain to the public what makes the digital euro so special and why it makes sense to exchange bank deposits for this asset.

Instability in the financial system can arise in particular if, as we expect, interest in the digital euro remains very subdued at first, but then jumps in a crisis because the digital euro then appears to be attractive as a store of value. Individual banks would then be confronted with additional

digital deposit outflows in a situation that is difficult for them anyway.

The existence of the digital euro could prove particularly problematic in situations where there is speculation about the **exit of individual member states** from the euro. The digital euro would then provide a hedge against the "redenomination risk": While euro balances at commercial banks would be redenominated into the national currency after an exit, digital euro balances would remain denominated in euros as a liability of the ECB. This feature of the digital euro could put additional pressure on banks in problem countries if their depositors exchange bank balances into digital euro balances on a larger scale.

In 7, we ask whether, given the enormous costs, the barely discernible use cases, the regulatory concerns, and the risks to financial stability, there might be an **alternative** that would also make it possible to strengthen European sovereignty in payments. We believe that it would make more sense for the ECB to pursue the integration of national bank payment systems within the framework of the European Payments Initiative. The experience of numerous countries shows that an integrated bank payment system based on QR codes as payment instrument no longer relies on the intermediary function of credit card companies. By negating the potential for integrating national systems, the ECB's concept ultimately perpetuates the dominance of U.S. credit card companies. With the digital euro, therefore, Europe's sovereignty is not strengthened but weakened.

Section 8 concludes the study.

2 Anatomy and functioning of payment systems

For an analysis of the "digital euro" (D€), it is central to clearly work out what is behind it. Basically, it can be stated that the term "digital euro" is misleading. When it was introduced on January 1, 1999, the euro existed only in digital form, namely as a credit balance at commercial banks. It was not until the introduction of cash on January 1, 2002 that the euro was also available in physical form.

2.1 Existing payment systems

To understand the concept of the digital euro, it is therefore necessary to look at the basic function of payment systems. Put simply, they are **communication systems** between the payer and the payee that have payment instruments, payment objects and a central settlement system.¹

¹The function of the settlement system is described by the ECB (2022c, p. 6) as follows „Settlement is defined as the completion of a payment transaction with the aim of irrevocably discharging all payment obligations between a payer and payee through the transfer of funds.“

On the one hand, this involves transmitting the information to the payee that he is receiving a payment from the payer (**information flow**). On the other hand, it must then be ensured that the payment between payer and payee actually takes place (**payment flow**) (table 1):

Payment systems	Payment-instruments	Payment-objects	Settlement-systems
Cash payment system	Banknotes, coins	Banknotes, coins	No central settlement system („peer-to-peer“)
Payment system of commercial banks	Bank transfers, girocard, checks, online payment	Bank deposits (=claim to central bank money)	Euro area: TARGET2 USA: CHIPS and Fedwire
Credit card payment system (VISA/Mastercard/American Express)	Credit cards, debit cards, mobile payment (Google Pay, Apple Pay) online payment	Bank deposits (=claim to central bank money)	Euro area: TARGET2 USA: CHIPS and Fedwire
Payment platforms (PayPal)	Mobile payment, online payment	Bank deposits (=claim to central bank money), balances on PayPal account	Internal accounting, if both sides hold a PayPal account. Without PayPal account: Euro area: TARGET2 USA: CHIPS and Fedwire
Digital euro online	Mobile payment, online payment	Digital euro	Settlement system for digital euro (N€XT) TARGET2 with waterfall functionalities
Digital euro offline	Mobile payment (digital wallet)	Digital euro	No central settlement („Peer-to-peer“)

Table 1: Systemic taxonomy of different payment systems

The **cash payment system** is characterized by the fact that cash is both a payment instrument and a payment object. Communication is simple, as both payer and payee are present at the time of payment. The payment flow consists of the physical transfer of banknotes and coins. For this reason, no central settlement system is required. The cash payment system is a **decentralized system**: this is also referred to as a "**peer-to-peer**" system.

In a pure **bank payment system**, there are various payment instruments (online and physical transfers, direct debits, standing orders, giro cards). The **payment object** is the credit balances held at the banks, which contain a claim to central bank money (=cash). When a transfer is made from one bank account (customer A) to another (customer B), it is not the bank balances that are exchanged but rather the claims to central bank money (figure 1). Accordingly, central settlement takes place via the TARGET2 or T2 payment system operated by the European Central Bank.² The payer's bank (Bank A) transfers central bank money (= central bank reserves) to the payee's bank (Bank B), which in return credits the payee's current account with the payment amount.

²The original TARGET system was replaced by the TARGET2 payment system in 2008. Currently, a merger of TARGET2 and TARGET2-Securities (a securities settlement system) is taking place, which will then operate under the name T2. For this study, the term TARGET will be used across the board to refer to the central bank payment system in the euro area between central banks and commercial banks.

Customer A	Bank A		Central bank	Bank B		Customer B
2.000€	5.000€	2.000€	5.000€	5.000€	2.000€	2.000€
Deposits	Central	Deposits	Reserves	Central	Deposits	Deposits
Bank A	bank	Customer	Bank A	bank	Customer	Bank B
	reserves	A	5.000€	reserves	B	
			Reserves			
			Bank B			

Transfer of 1.000€ **bank deposits** (entitlement to central bank money) from customer A to customer B.

The transaction is settled in **central bank money** via the central bank payment system.

Customer A	Bank A		Central bank	Bank B		Customer B
1.000€	4.000€	1.000€	4.000€	6.000€	3.000€	3.000€
Deposits	Central	Deposits	Reserves	Central	Deposits	Deposits
Bank A	bank	Customer	Bank A	bank	Customer	Bank B
	reserves	A	6.000€	reserves	B	
			Reserves			
			Bank B			

Figure 1: Bank deposit transfer

In the bank payment system, it is necessary to distinguish between two directions of payment and information flows (ECB (2010a) and ECB (2010b)):

- In the case of credit transfers or **direct credit**, the initiative comes from **the payer**. For example, in the case of a bank transfer, the information is triggered by the payer. The payment stream flows in the direction of the information stream.
- With **direct debit**, the initiative comes from **the payee**. In the case of a debit balance, for example, the information is triggered by the payee. The payment stream flows then in the opposite direction of the information flow.

Card and online payments within the bank payment system take the form of „direct credit“, as the information and payment flow originate from the payer’s bank. Digital payment instruments such as debit cards, online payments, Google Pay or Apple Pay are taking the place of the classic bank transfer. The decisive factor here is that the authorization of the payment as well as the checking of the account coverage and compliance with the daily limit is carried out by the **card-issuing institution**. Chart 2 illustrates how the information and payment flows in the Giro pay system of German banks work.

One payment instrument that significantly expands the usability of the bank payment system is **merchant QR codes**. When the customer scans the code, the payment process is triggered at the

customer's bank in the same way as a traditional bank transfer. Successful payment systems based on QR codes as a payment tool include Switzerland's TWINT and Brazil's Pix system. From the point of view of commerce, this solution has the advantage that no payment terminals are required, which can save costs.³

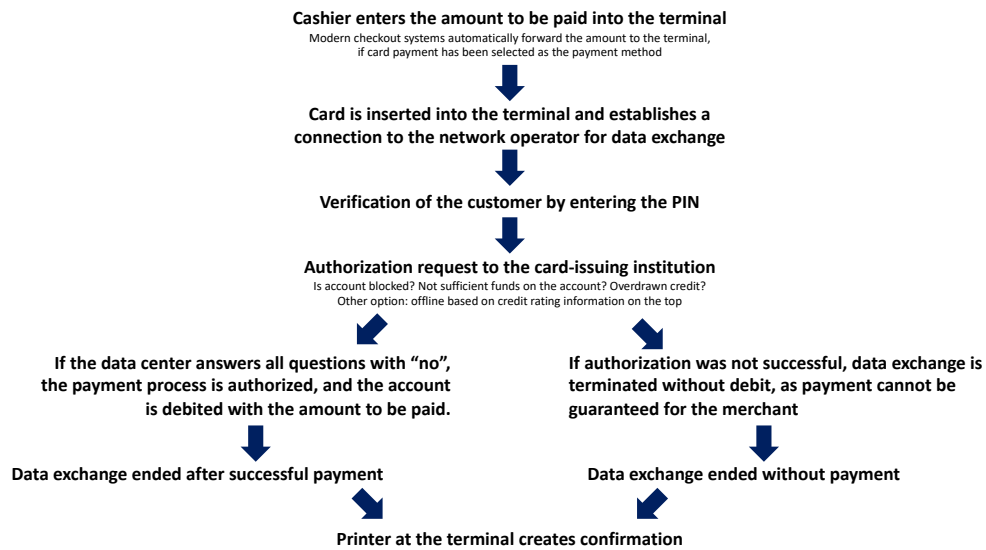


Figure 2: Technical process of a payment in the Giro pay system (based on [Kreditkarte.net](https://www.kreditkarte.net) (2023))

Credit card systems are communication systems that are based on the bank payment system and thereby enable payments between banks that do not have a common communication system. Thus, the customer is not able to initiate the transaction process in the form of „direct credit“ through his own bank. Credit card systems are therefore characterized by transactions of the „direct debit“ type, where the transaction process originates from the payee's bank. Since the latter is not itself able to contact the payer's bank, a **credit card company as intermediary** is needed.

To understand how a credit card system works, one must distinguish between

- the bank of the payer that issued the credit card for the payer ("**Issuer**"), and
- the payee's bank, which the payee has selected for its credit card transactions ("**acquirer**").

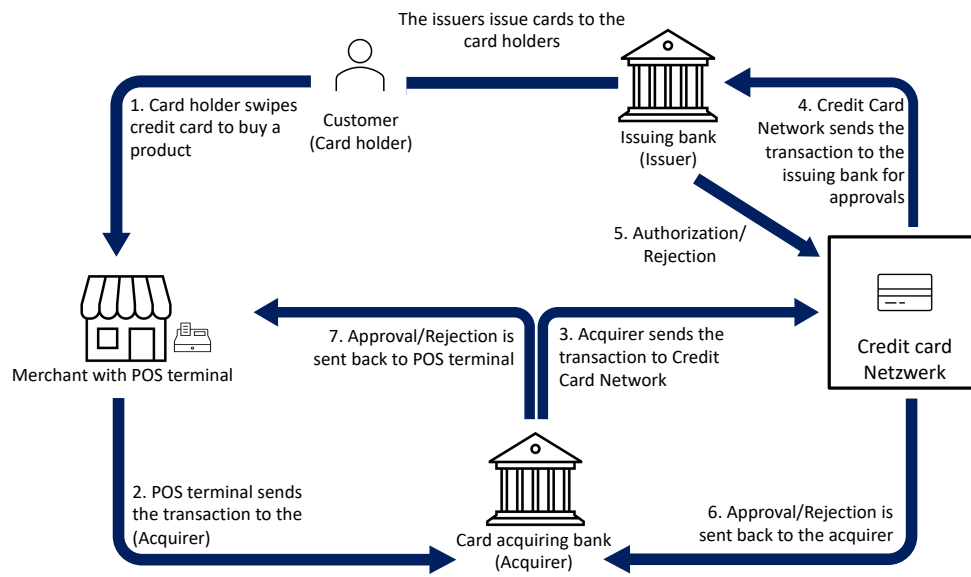
In simplified terms, a **credit card transaction** for a "debit card" proceeds in the following steps (figures 3a and 3b):

- 1) The credit card holder enters his data at the merchant.
- 2) These are sent to the merchant's acquirer (=bank) via a payment gateway.

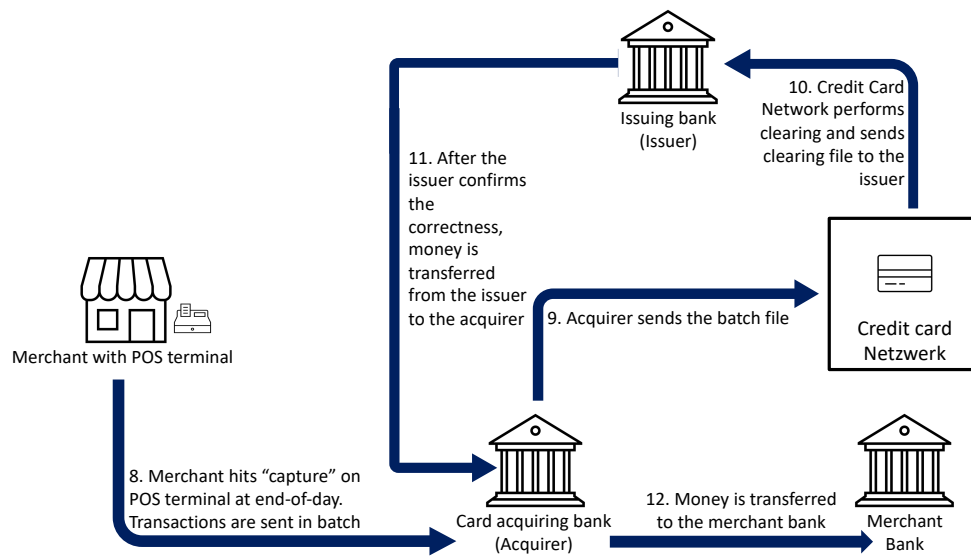
³In emerging countries with an irregular power supply, this system has the added advantage that transactions are possible as long as the buyer has a charged smartphone.

- 3) The acquirer sends the data to the credit card system.
- 4) The credit card system forwards the data to the issuer (=bank of the buyer).
- 5) The issuer confirms to the credit card system that the card is legitimate (authentication) and that sufficient funds are available.
- 6) The card system forwards the response to the acquirer.
- 7) The acquirer forwards the information to the merchant.
- 8) At the end of the day, the merchant sends the collected transactions to the acquirer.

The latter forwards the data via the credit card company (9) to the issuer (10). A payment is then made from the buyer's bank (issuer) to the seller's bank (11+12), corresponding to the transactions shown in figure 1.



(a) Credit card transaction authorization flow



(b) Credit card transaction capture and settlement flow

Figure 3: Credit card transaction representation (based on Xu (2022))

It becomes clear that, in the case of a **debit card**, the credit card company performs purely a communicative function which considerably expand the possible uses of the bank payment system. In particular, **international transactions in different currencies** are possible.

In the case of a **credit card**, a credit function is added. The buyer's transactions are usually accumulated over a month and only then billed to his bank. This leads to a reduction in information costs for the credit card company, since it is not necessary to check with the buyer's bank until the

buyer has exhausted his credit limit. At the same time, payment transactions are reduced, since the payment with the buyer is made only once a month. However, interest costs are incurred by the credit card company. In the case of a credit card, therefore, transactions 4) and 5) are generally omitted from figure 3a.

A specific payment system is **PayPal**. Compared to the credit card system, it is characterized by the fact that participants can hold funds on their PayPal account. Thus, the system enables payments with its own payment object. This allows internal settlement between payer and payee without having to involve the bank payment system. Payments are made as „**direct credit**“, since the payer is always able to initiate the transaction at PayPal. While payments are generally made to a PayPal account of the payee, it is possible for the payer to pay without a PayPal balance. Both a credit card account and a bank account can be used as a payment source. PayPal is thus a **hybrid system**:

- It enables full payment transaction within its system and in this respect is a **substitute for the bank payment system**.
- However, it can also be used as a communication system between the PayPal account of the payment recipient and an external account of the payer. In this case, the payment is processed via TARGET between the payer's bank and PayPal, which acts as the bank.

The use of PayPal currently extends mainly to online commerce. Compared to the credit card system and the bank payment system, it has the advantage that simple payments between private individuals are also possible with it.

Based on these examples, it is clear that today there is a very diverse payment ecosystem that allows merchants and consumers to conduct their transactions in the way that is best for them. In the words of [Ugolini \(2017, p. 22\)](#):

„[...] different payment systems actually coexist (often concerned with transfers of different nature, like credit card networks, derivatives clearinghouses, or foreign exchange markets), but it is the interaction among all of them that constitutes the economy's payment system proper.“

2.2 The digital euro payment system

With this systemic perspective, it is now possible to identify which functions the digital euro should perform. Thereby, a distinction must be made between the online and offline functions of the digital euro. We describe the characteristics of the digital euro as a new payment object, the communication system required for it to function, and the settlement system required to fulfill the payments.

2.2.1 The digital euro as a payment object

To understand the digital euro, it is first important to define its economic and legal character. As the ECB makes clear, the digital euro, like cash, is a **liability of the Eurosystem**:

„Holding a digital euro would amount to a direct claim against the central bank – as is the case with banknotes today. This means that the digital euro would be a liability on the balance sheet of the Eurosystem.“ (ECB, 2022c, p. 1)

It should be borne in mind that, just as with cash, the ECB has no obligation to redeem the digital euro vis-à-vis the holder of such an asset. The term "liability" is therefore not to be understood in a debt law sense, but solely in an accounting sense.

In the case of the **online solution**, the accounts denominated in digital euros are to be held by commercial banks not by the ECB:

„Supervised intermediaries, and not the Eurosystem directly, would have a contractual account management relationship with the end user. [...] The Eurosystem would not be able to infer how many digital euro any individual end user held nor to infer end users' payment patterns“ (ECB, 2022c, p. 7)

The information on the individual credit balances in the digital euro accounts is therefore not to be stored centrally, but **decentrally** at the commercial banks managing the accounts. Legally, these accounts would in principle correspond to the function of **notary escrow accounts**, where the notary acts as the administrator of an account. In the case of the digital euro, this function would be performed by the commercial banks.

In the case of the **offline solution**, the credit would be stored directly on a mobile device (smartphone).

In order to prevent a shift of bank deposits that would lead to disintermediation and impair the refinancing of banks (chapter 4.3), the ECB intends to set a **limit on deposits in digital euros**. This has not yet been officially specified. It is said that an amount of 3,000 euros brought up for discussion by Bindseil (2020) is rather too high.

The **limit** implies that if transfers result in a credit balance above the limit, there must be an automatic mechanism that transfers the excess amount to a traditional bank account. The ECB refers to this as "**defunding**" and a **Waterfall functionality**:

„When receiving a payment, liquidity exceeding the holding threshold would be automatically pushed to a linked private money account chosen by the end user.“ (ECB, 2022c, p. 8)

At the same time, since there are **no overdraft facilities** for the digital euro account, there is a need for additional "**funding**" or **reverse water functionality** if the balance is not sufficient to make a transaction:

„Similarly, at the discretion of the end user, a reverse waterfall functionality would ensure that end users could make a payment even if the amount exceeded their current digital euro funds. Additional liquidity would be pulled from the linked private money account and the transaction would be completed in digital euro at its full value.“ (ECB, 2022c, p. 8)

For merchants, an upper limit of zero should apply. This means that the waterfall must be triggered for each individual incoming payment in order to carry out the necessary defunding. This would make it impossible to aggregate the transactions made during the course of the day, as is intended in a credit card system to ease the burden on the settlement system.

„Merchants and governments in the euro area would have zero-holding limits.“ (ECB, 2023d, p. 1)

2.2.2 The communication system for digital euro payments

In section 2.1, we worked out that credit card and online payments require a communication system that signals to the merchant the buyer's ability to pay and organizes the payment process. While for bank cards the request goes directly to the issuing bank, for credit cards the communication process goes through the credit card companies.

In the case of the digital euro, the ECB plans for this communication function to be performed by intermediaries rather than by the ECB itself (figure 4). The functions described here - initiating the transaction, authentication, validation and transfer to an account (post-settlement) - are in principle identical to the functions performed by credit card companies today. Communication takes place between the bank that manages the merchant's digital euro account and the bank that manages the customer's digital euro account.

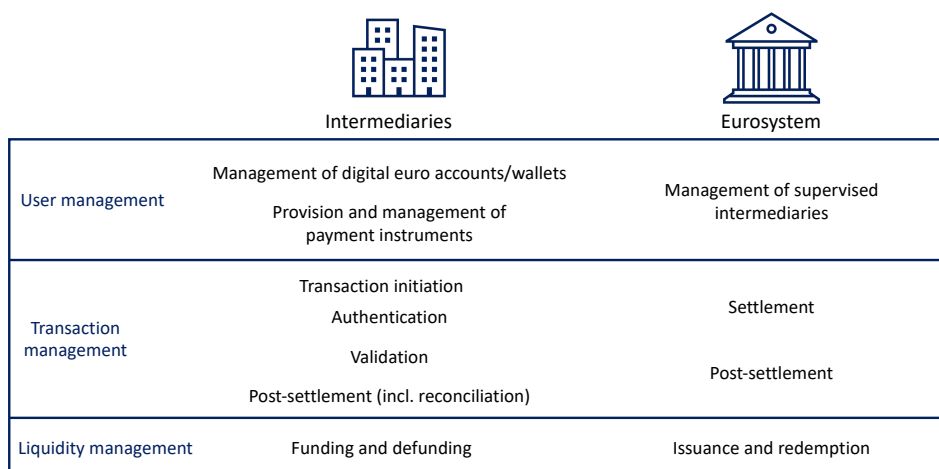


Figure 4: Distribution of roles between intermediaries and the Eurosystem (based on ECB (2022c, p. 6))

However, due to the waterfall functionalities, the relationships are more complex. For example, if the customer's digital euro balance is insufficient, an additional request must be made to his bank to see if the payment can be processed via the traditional account.

Since the digital euro is to be used throughout the whole euro area with its 20 member states and 4,018 commercial banks, a provider capable of setting up and operating a correspondingly comprehensive communications system is needed. The financial incentives must be high enough to cover the fixed and system costs. A further complicating factor in the start-up phase is that transaction volumes are likely to be rather modest, and thus ongoing revenues low. Given the high investment costs required to set up such a pan-European payment infrastructure, it is therefore anything but self-evident that the ECB will find one or more operators for this system. The two major credit card companies are most likely to be able to do this, as it would be comparatively easy for them to set up a parallel information channel between acquirer and issuer for digital euro accounts.

2.2.3 The settlement system for digital euro payments

Because it is a liability of a central bank, the digital euro requires an independent settlement system.⁴ The TARGET system operated by the ECB is not suitable for this purpose, as it is a payment system for transactions between banks. For transactions with the digital euro, a **payment system between non-banks** is needed. This is to be operated by the ECB, which will also bear the

⁴It is therefore inaccurate when the European Commission (2023b, p. 9) states: „Since the online digital euro would likely use similar infrastructure as currently available payment means, the energy consumption and thus environmental impact is expected to be similar to existing payments.”

necessary costs.

„The digital euro back-end prototype for online payments, called N€XT, is a bespoke design developed from scratch by the Eurosystem. The architecture of N€XT is not that of a distributed ledger, rather it is based on a UTXO data model which has been made popular by distributed ledger technologies (DLTs).“ (ECB, 2023b, p. 5)

The introduction of the digital euro would thus lead to a **coexistence of TARGET and N€XT**. Figure 5 illustrates how a payment would be processed in such a system. Customer A now holds two accounts, both of which are managed by Bank A. The digital euro account, however, is not a liability of bank A.

First, Customer A transfers funds from his bank account to his digital euro account. When paying customer B, digital euros are now transferred directly from customer A's digital euro account to customer B's digital euro account. This results in a reallocation of the central bank's digital euro liabilities on its balance sheet. However, since these are not identifiable for the ECB, their total amount of digital euro liabilities remains unchanged.

Transfer of 1.000€ bank deposit via digital euro payment system from customer A to customer B:

Customer A	Bank A		Central bank	Bank B		Customer B
2.000€	5.000€	2.000€	5.000€	5.000€	2.000€	2.000€
Deposits	Central	Deposits	Reserves	Central	Deposits	Deposits
Bank A	bank	Customer	Bank A	bank	Customer	Bank B
	reserves	A	5.000€	reserves	B	
			Reserves			
			Bank B			

1) Transfer of bank deposits to digital euro account (Funding).

Customer A	Bank A		Central bank	Bank B		Customer B
1.000€	4.000€	1.000€	4.000€	5.000€	2.000€	2.000€
Deposits	Central	Deposits	Reserves	Central	Deposits	Deposits
Bank A	bank	Customer	Bank A	bank	Customer	Bank B
1.000€	reserves	A	5.000€	reserves	B	
digital			Reserves			
euro			Bank B			
			1.000€			
			digital			
			euro			

2) Transfer of digital euro from customer A to customer B.

Customer A	Bank A		Central bank	Bank B		Customer B
1.000€	4.000€	1.000€	4.000€	5.000€	2.000€	2.000€
Deposits	Central	Deposits	Reserves	Central	Deposits	Deposits
Bank A	bank	Customer	Bank A	bank	Customer	Bank B
	reserves	A	5.000€	reserves	B	1.000€
			Reserves			digital
			Bank B			euro
			1.000€			
			digital			
			euro			

3) Exchange of digital euro from customer B into bank deposits (Defunding).

Customer A	Bank A		Central bank	Bank B		Customer B
1.000€	4.000€	1.000€	4.000€	6.000€	3.000€	3.000€
Deposits	Central	Deposits	Reserves	Central	Deposits	Deposits
Bank A	bank	Customer	Bank A	bank	Customer	Bank B
	reserves	A	6.000€	reserves	B	
			Reserves			
			Bank B			

Figure 5: Transaction with digital euro including waterfall functionality

The two **waterfall functionalities** thereby lead to increased complexity. When customer B makes a "defunding" (transfer from the digital euro account to the traditional bank account), another settlement in the TARGET system is required. Customer B's bank receives additional central bank funds and credits the customer's bank account with the corresponding amount.

Compared to a traditional payment (figure 1), this can result in a **tripling of transactions**. This is the case when, as described here, Customer A must first make a transfer from the traditional account to the digital euro ("funding") and the payment goes to a merchant (Customer B) who is subject to 100% defunding by the waterfall.

In comparison, payments with the **"offline" digital euro** are relatively simple. digital euros would simply be transferred from the wallet of one smartphone to the wallet of another smartphone. This is a "peer-to-peer" transaction that, as in the case of cash, does not require a complex communication system or a central settlement system.

2.2.4 Duplication of payment systems

The description of the key features of the digital euro makes it clear that this innovation in the online variant leads to a duplication of existing systems.

- At the level of communication of online transactions **between buyer and seller**, there is a need for a Europe-wide communication system for the digital euro accounts managed at the individual banks. Such a system must ultimately fulfill all the functions currently performed by credit card systems.
- At the level of the **definitive settlement of payments**, the ECB must develop N€XT, a parallel system to TARGET, which settles all transactions.
- Due to the zero-holding limit for merchants, an **additional transaction** must be carried out **in the TARGET system** for each payment with the digital euro.

The complexity of a payment system based on the digital euro becomes clear when compared with the bank payment system and the bank payment system extended by a credit card system. The simplest solution would be an integrated European bank payment system that has payment instruments such as the QR code. Since all transactions originate from the payer's bank, there would be no need for a credit card system as an intermediary between banks. The status quo is characterized by a lack of integration, requiring intermediaries. It is characteristic of the digital euro project that the ECB assumes the need for credit card companies as intermediaries between banks in the long run. In doing so, it expresses the fact that it does not consider the integration of

national banking systems to be feasible. The problem with such a „second best“ solution is that it perpetuates the business model of the credit card companies. In addition, the creation of a new payment object and the associated waterfall functionalities require complex parallel structures (Figure 6).

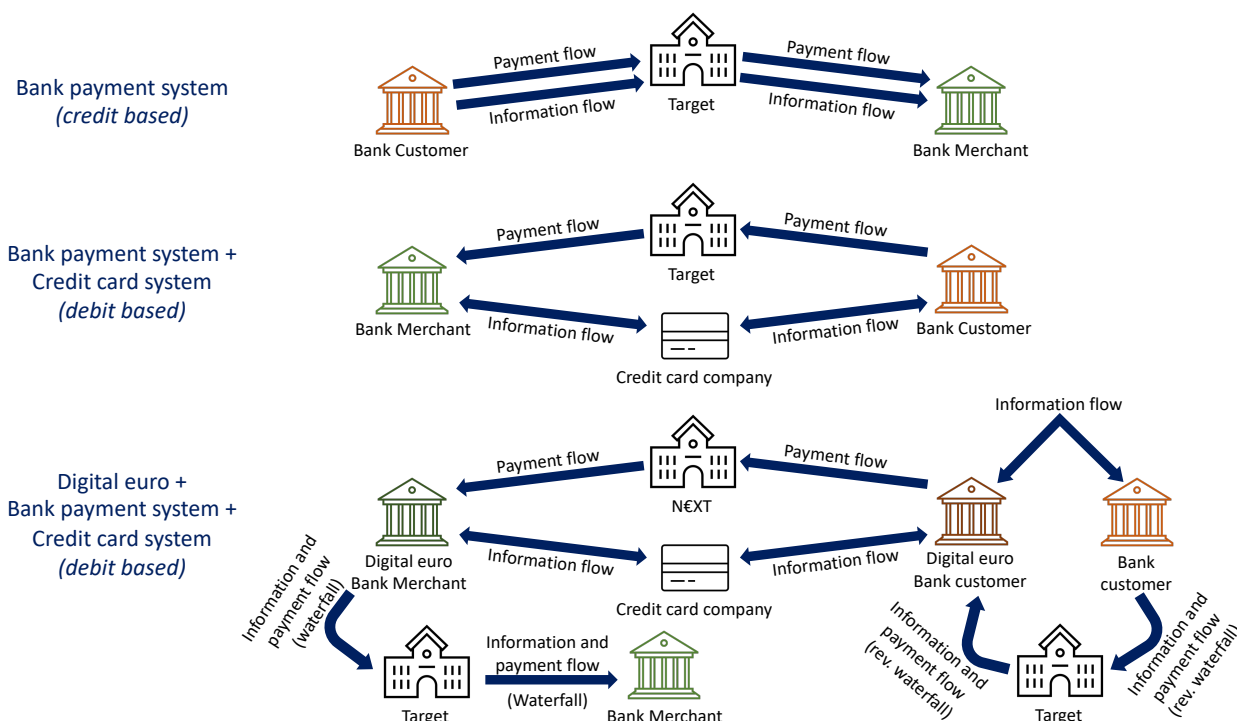


Figure 6: Comparison of different transaction flows

2.2.5 Digital euro: Payment system or payment object

The detailed description of these processes makes it possible to clearly determine what is behind the term "digital euro". At its core, it is a **new payment object** that can be understood as a **hybrid of cash and bank deposits** or as "digital cash".

- What the digital euro has in common with cash is that it is an irredeemable **liability of the central bank**.
- As with cash, the digital euro enables transactions that are **not settled via the banks' central bank balances**.
- In the offline version, as with cash, the digital euro can be used to carry out **peer-to-peer** transactions that would not be recorded by any central settlement system.
- Unlike cash, the digital euro makes it possible to conduct **online transactions**.

Leaving aside offline transactions, the ECB has not yet explained how it envisages designing the communication system between the banks holding the individual digital euro accounts. The ECB seems to assume that private providers will be found who are willing to establish such a system infrastructure for the digital euro payment object it has established. Since such a bridge between the banks holding the digital euro accounts is the central element of such a payment system, there is thus a **massive void** in the ECB's overall project. In principle, it cannot be ruled out that this task is not sufficiently profitable and thus unattractive for private providers. This conceptual deficit is all the more worrying because the European Commission sees a major advantage of the digital euro in the area of payment systems:

„The digital euro will also be offered as a public digital means of payment, alongside the existing private digital means of payment, supporting a stronger and more competitive, efficient and innovative European retail payments market and digital finance sector, and contributing to further enhance the resilience of the European retail payments market as well. As such, the digital euro will facilitate the development of pan-European and interoperable retail payment solutions, including the full roll-out of instant payments.“ ([European Commission, 2023b](#), p. 1)

3 The business case for citizens, merchants and financial service providers

In view of the great effort involved in establishing parallel system structures, the question arises, on the one hand, as to what benefits the digital euro offers citizens in their function as consumers and traders, but also the financial system.

The ECB is aware of the fact that the digital euro can only be successful if it is used by Europeans in their everyday lives. The design of the digital euro must therefore offer added value compared to existing payment solutions. The ECB is convinced that this will indeed be the case:

„If carefully designed and introduced, a digital euro could play a decisive and beneficial role in this endeavour and serve as a truly public good that would benefit the economy and society as a whole.“ ([ECB, 2022a](#), p. 2)

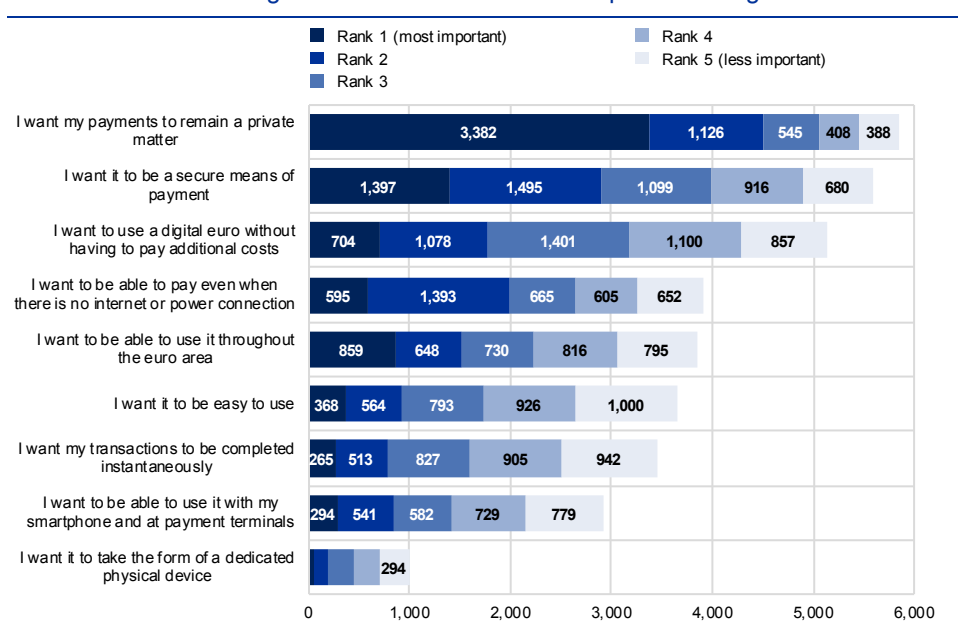
But apart from the reference to offering users broad acceptance, ease of use, low cost, fast processing, security, and privacy, one finds no concrete examples from the ECB of the particular "use case" of the digital euro ([ECB, 2022a](#)) and thus no evidence for its claim that the digital euro is beneficial

to the economy and society as a whole.

A survey conducted by the [ECB \(2021\)](#) on citizens' preferences regarding a digital euro yielded few concrete results in this regard, which were also not surprising (figure 7). The three most important preferences are as follows:

- Payments should remain a private matter.
- It should be a secure means of payment.
- There should be no additional costs involved.

Preference for some digital euro features based on top five rankings



Note: Number of respondents not shown for the option "I want it to take the form of a dedicated physical device": rank 1 (47), rank 2 (139), rank 3 (254), rank 4 (263).

Figure 7: ECB survey on preferences for digital euro features (Source: [ECB \(2021, p. 11\)](#))

We will therefore specifically review, for both online and offline use, what the advantages of the digital euro might be for consumers and retailers.

3.1 Online usage

For online use, we distinguish between the use of the digital euro as a payment object used within existing payment systems and a payment system based on the digital euro.

3.1.1 Digital euro as a payment object

The advantages and disadvantages concern the security, cost and anonymity of the digital euro compared to a traditional bank account.

Security

At the object level, the digital euro can be compared with a traditional bank deposit: While bank deposits only contain a claim to central bank money, the digital euro is directly central bank money. Compared with the digital euro, bank deposit thus have the disadvantage that they might no longer be redeemed in the event of a banking crisis. However, due to state deposit insurance, this difference is not relevant for **bank deposits of up to 100,000 euros**. For amounts above this, however, this aspect would be significant in the event of a bank collapse. Due to the EU Bank Recovery and Resolution Directive (BRRD), **bail-in**, i.e. the joint liability of creditors, is one of the four restructuring instruments. From this point of view, **investors with high assets** might well have an incentive to invest part of their funds in an absolutely secure manner as credit balances at the ECB. The digital euro would then not be used as a **means of payment**, but as a **store of value**. However, the very low upper limit for digital euro deposits explicitly rules out this use case.

The security aspect could also play a role for smaller amounts if citizens see the **risk of their country leaving the euro**. As the Greek crisis showed, it was at times not possible to exchange bank balances for cash. Such a restriction would not be possible for balances in digital euros. This could lead to a deposit withdrawal within the specified limits, which would have a crisis-reinforcing effect (section 6).

Costs

The cost of account management is likely to play an important role in the attractiveness of a digital euro Account. The ECB wants to oblige **banks** to offer all services associated with account opening and management **free of charge**:

„The Eurosystem believes that a digital euro should be free for basic use by private individuals. Private customers should not be charged for basic use of digital euro, and distributing PSPs would not be remunerated for providing these fundamental services. This would be consistent with the provision of cash.“ (ECB, 2023c, p. 5).

However, since a digital euro account can generally only be opened in conjunction with a traditional bank account, this does not result in a complete savings in account maintenance costs for

bank customers.⁵

For the case that an attractive payment system for the digital euro is established, the waterfall functionalities offer the option of using the system even without corresponding account balances. To do this, the account holder must set the individual upper limit to zero.

Anonymity

When using the digital euro online, there are no fundamental differences in terms of anonymity compared with using a traditional bank account.

3.1.2 Systemic view

What advantages the digital euro will offer from a systemic point of view is difficult to assess, as the ECB has not yet developed a clear concept for it. If the system is organized by the existing credit card providers, it is not clear that anything fundamental will change as a result.

The central question is whether merchants will be willing to accept payments in digital euros. To ensure this, the Commission's proposal in article 7 ([European Commission, 2023b](#), p. 42) provides for the digital euro to be granted an almost unlimited status as a **legal tender**. This status is to go beyond the status that cash has enjoyed to date. Whereas companies are currently able to exclude the acceptance of cash as a matter of principle, this is to be ruled out in the case of the digital euro. This is set out in Article 10:

„Payees subject to the obligation to accept the digital euro shall not use contractual terms that have not been individually negotiated or commercial practices which have the object or the effect to exclude the use of the digital euro by the payers of monetary debts denominated in euro.“
([European Commission, 2023b](#), p. 43)

The only exceptions are for small companies with fewer than 10 employees or a turnover or balance sheet total of less than 2 million euros (article 9, [European Commission \(2023b\)](#), p. 42f)). This effectively forces all companies to open a digital euro account, although the waterfall functionality means that no significant balance can ever be held on these accounts.

⁵In principle, it is also possible to open a digital euro account without having your own bank account. This is also intended to contribute to financial inclusion. However, due to the presumably low upper limits for digital euro balances, a digital euro account will not be sufficient for most citizens and an additional bank account will be required. Also, the use of services such as the waterfall functionality is only possible with a connected bank account.

3.2 Offline usage

The use case for offline use is primarily derived from the comparison with cash. As mentioned above, the digital euro can also be referred to as "**digital cash**" in this context. For this use, the customer must transfer an amount from his digital euro account or bank account to a digital wallet in his smartphone. In this respect, this corresponds to a cash withdrawal in the previous system.

Therefore, then, the digital euro shares some **serious disadvantages of cash and the cash payment system** as a whole. Compared with digital payment systems, the cash system has the disadvantage that the **payment object** must be **present at the time of payment**. This means that there is a risk that the payment object may be lost or that it may be stolen. With a wallet on the smartphone, there is also the risk of loss. In addition, there is the risk that criminals, who know the possibilities of the digital euro, will force citizens to load the maximum amount onto the smartphone and then hand it over offline. Incidentally, the Commission explicitly mentions the advantage of the digital euro in "underground car parks".⁶

In contrast, cash has a number of advantages over the digital euro in terms of offline functionality:

- It does not require electricity, so there is no problem of no longer being able to make a payment because the smartphone battery has discharged. It is thus the only possible payment option even in disaster situations that lead to the collapse of the power grid.
- It guarantees **absolute anonymity** even for larger payments, whereas only comparatively small amounts are likely to be possible for offline payments with the digital euro due to money laundering regulations.

Similar to cash, anonymous payments are to be possible with the offline digital euro. However, these are only possible to a limited extent under "anti-money laundering" (AML) and "countering the financing of terrorism" (CFT) regulations. According to current proposals by the European Commission, cash payments will only be possible up to an amount of 10,000€ within the euro zone in the future. The limit for anonymous payments with the offline digital euro is to be set significantly lower. With the 5th Money Laundering Directive, the conditions under which e-money products can be issued anonymously are extremely strict ([European Parliament and Council, 2018](#); [Schindele, 2018](#)):

- The maximum top-up amount for e-money, which can be spent anonymously, has been reduced from EUR 250 to EUR 150. In addition, the maximum cash reload amount has been capped at just EUR 50. German lawmakers have set the limits at EUR 100 and EUR 20, respectively.

⁶ „Significantly, it would be available for payments both online and offline, i.e. payments could be made from device to device without an internet connection, from a remote area or underground car park.“ ([European Commission, 2023c](#))

- Online payments processed via anonymous e-money products may not exceed EUR 50.
- Acquirers may only process payments with anonymous prepaid cards from a third country if these cards are issued in the third country with similar restrictions.

The **advantage of the anonymity of cash** is probably the decisive reason why, for the most important currencies, the amount of cash in circulation has been growing faster than nominal GDP for years (figure 8).

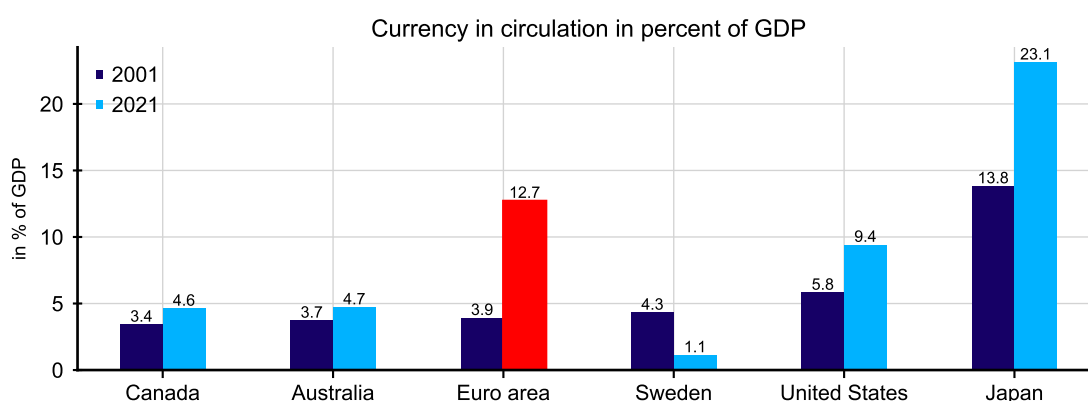


Figure 8: Currency in circulation in relation to GDP (Source: IMF, AMECO)

At present, it has not yet been conclusively decided to what extent completely anonymous payments will be possible with an offline digital euro. For example, [Panetta \(2022\)](#) has stated:

„Full anonymity is not a viable option from a public policy perspective. It would raise concerns about the digital euro potentially being used for illicit purposes.“

For the offline version of the digital euro, therefore, only higher privacy standards are to be possible than with the online solution, but not full anonymity. On the other hand, the offline digital euro should only allow transactions with lower volumes ([ECB, 2022b](#)).

In addition to its unrestricted anonymity, cash would also continue to offer the only possibility of holding **central bank money as a store of value** on a scale that exceeds the expected low holding limit for the digital euro.

The advantages of the digital euro over cash as a digital offline means of payment appear relatively limited. Even on airplanes, it has long been possible to pay offline with credit cards. In remote mountain huts, this functionality could perhaps be advantageous. However, since there would be no obligation for operators to accept it, one would be well advised to also continue to carry

appropriate cash balances.

Our skeptical assessment of the advantages of the digital euro in offline functionality is in line with the results of a study conducted on behalf of the ECB with focus groups on their assessment of "digital wallets" (Kantar Public, 2023, p. 6):

„The general population perceived offline payments to be the most innovative digital wallet feature with its use in specific situations, e.g. in areas without internet coverage, when mobile data isn't available, or when using flight mode. Despite this, most participants expected they would not use offline payments very often.“

4 The costs of the digital euro

Overall, the duplication of structures and the possible triplication of transactions result in significant macroeconomic costs. This was also seen as such by the ECB:

„Parallel infrastructures for private payment solutions [...] would be costly, given the nature of payment systems as a network industry, and less likely to be introduced by private profit-oriented entities. Having a parallel infrastructure for the digital euro seems especially costly and unlikely if supervised intermediaries are involved not only in the onboarding of users but also in the processing of their transactions.“ (ECB, 2020, p. 33)

The Bank for International Settlements takes a similar view:

„Designing an rCBDC [retail CBDC] system is a major undertaking, involving a multitude of requirements and stakeholders that might lead to conflicting demands.“ (BIS, 2023, p. 12)

In the following, the costs associated with the introduction and maintenance of the digital euro will be estimated. These costs will be incurred by the ECB or the Eurosystem itself, European citizens, retailers, banks and the payment service providers involved.⁷

4.1 Costs for the ECB and the taxpayer

The costs to the ECB of establishing a completely new parallel settlement system and, more generally, of establishing the digital euro are likely to be substantial. The ECB points out that the Eurosystem bears its own costs.⁸ Compared to the existing system, in which, as shown above, most

⁷ „The implementation costs of the initiative would mainly fall on the European Central Bank, merchants and PSPs.“ (European Commission, 2023b, p. 9)

⁸ „The Eurosystem has proposed that it would bear its own costs [...]“ (ECB, 2023c, p. 7)

payments are settled via TARGET, the ECB actually loses revenue. This is because the ECB charges participating parties fees for using TARGET.⁹ However, the ECB does not want to charge payment service providers for settling payments with the digital euro:

„PSPs would bear their own costs related to the distribution of the digital euro services they provide, but they would not be charged Eurosystem costs related to scheme management and the settlement processing. [...] The Eurosystem would take over costs related to setting and monitoring compliance with the rules and standards of the digital euro scheme. It would also cover the costs of performing the settlement activities (i.e. verifying and recording the transaction) on behalf of the supervised intermediaries that distribute digital euro to end users.“
(ECB, 2023c, p. 7)

However, the costs for the ECB have to be borne indirectly by **European citizens**, in that the higher expenses of the Eurosystem reduce central bank profits and thus also central bank profit distributions to governments.

The **costs for the private sector** result from the establishment of the parallel account system and its ongoing maintenance. They also result from either the need to establish and maintain new infrastructures for interbank communication or the need for existing payment service providers to establish and maintain parallel communication channels.

4.2 Costs for private households

Private households should **not incur any costs** for opening and maintaining digital euro accounts or for using them for basic services such as simple payments. Additional services for which users may incur costs could be specific payment instruments or functions such as recurring, regular payments (ECB (2023d, p. 10) und ECB (2023c, p. 6)). According to the Commission’s proposal, customers should even be able to open several digital euro accounts (European Commission, 2023b, p. 47).

4.3 Costs for the commercial banks

Accordingly, the costs of opening and maintaining accounts would have to be borne by **commercial banks**. They would have to open the accounts and offer a variety of services related to the accounts **free of charge** (Box 1):

⁹The ECB on the rationale for TARGET user fees: *„The goal of the pricing scheme is to recover the costs of operating TARGET2 taking into account a so-called public good factor“* (ECB, 2023e)

Box 1: Core services to be performed by banks free of charge (Source: ECB (2023d, p. 10)):

- (i) Opening a digital euro account, onboarding and “Know Your Customer”
- (ii) Closing a digital euro account and offboarding end users
- (iii) Payment instrument management (provision and maintenance)
- (iv) Linking the digital euro account to a payment account
- (v) User life cycle management processes
- (vi) Funding (manual and automated)
- (vii) Reverse waterfall
- (viii) Defunding (manual and automated)
- (ix) Waterfall
- (x) Transaction initiation (one-off transactions)
- (xi) Authentication
- (xii) Payment confirmation/rejection notification
- (xiii) Refunds
- (xiv) Dispute/exception management

The ECB invokes the comparison with cash for the need to open and maintain an account free of charge:

„[Free basic use] is consistent with the context of cash, which is a public good as well, where people can pay, be paid, and have access free-of-charge.“ (ECB, 2023a, p. 7)

However, the comparison only applies to cash withdrawals by a customer from his own bank. Otherwise, ATM withdrawals from third-party banks are subject to fees, some of which are considerable.¹⁰ In addition, there are considerable cash processing costs for retailers, which must, however, be borne indirectly by customers.

From a legal point of view, it would have to be examined whether the Commission can force commercial banks to perform a **public function** without receiving **compensation**.

Significant costs arise for banks when customers switch bank deposits to digital euro deposits on a large scale. They have to compensate for the **loss of refinancing** by reducing balances at the central bank. If their reserves are not sufficient for this, they have to take out refinancing loans from the ECB. This worsens the banks’ liquidity position and their earnings situation, and can thus have a negative impact on lending.¹¹

¹⁰In Austria, fees for cash withdrawals are still often borne by the banks themselves, but an ECB survey shows that also in Austria more than 30% of respondents said they already pay fees for cash withdrawals at least sometimes (ECB, 2022d, p. 50).

¹¹„Furthermore, the potential conversion of funds placed in PSPs (especially credit institutions) to digital euro can reduce the PSP’s liquidity situation, interest income and may affect credit provision.“ (European Commission, 2023b, p. 9)

A study by the European Commission ([Bellia and Calès, 2023](#)) examines the impact of a shift from bank deposits to the digital euro on the profitability of banks in the euro area.

ROE	Status Quo representative bank	Digital Euro moderate demand	Digital Euro capped scenario 3k	Digital Euro large demand
All sample	4.28%	4.24%	4.13%	3.31%
Large	3.65%	3.61%	3.51%	2.75%
Medium	5.10%	5.06%	4.92%	3.78%
Small	3.70%	3.66%	3.52%	2.39%

Table 2: Impact of a digital euro on the profitability of banks (Source: [Bellia and Calès \(2023, S. 22\)](#))

Table 2 shows the effect of different scenarios on banks' return on equity (ROE). A distinction is made between small, medium and large banks and the overall effect is shown for all banks in the data set (all sample). The "representative bank" column serves as a baseline before the introduction of a digital euro. The "Moderate demand" scenario assumes digital euro balances of up to 1,500€ per person. The "Large demand" scenario assumes a maximum value of 14,000€ per person. The "Capped 3k" scenario assumes an upper limit of 3,000€ per person.

- In the scenario that assumes a cap of 3,000 € digital euros per person, banks' return on equity decreases on average from 4.28% to 4.13%. The impact hits smaller banks (3.70% to 3.52%) harder than large banks (3.65% to 3.51%), as they rely more on deposit funding.
- For a higher cap of up to 14,000€ ("Large demand"), the impact is much stronger with a return on equity of 3.31% for the whole sample and 2.39% for small banks.¹²

In their study, the authors warn that the introduction of a digital euro could mean „*substantial challenges*“ ([Bellia and Calès, 2023](#), p. 26) for the profitability of banks, especially smaller financial institutions. It should also be noted at this point that these values apply to an **average of the banks** in the data set (about 60% of the institutions in the data set of the study are from only three euro area countries: Germany, Austria and Italy). Accordingly, the impact on individual institutions could be much more heterogeneous. This is also pointed out by [Petracco Giudici and Di Girolamo \(2023, p. 1\)](#) in their study on the impact of a digital euro on the balance sheets of European banks:

„Results show that per capita demand scenarios around 3 thousand euro do not seem to present risks for financial stability in the aggregate, though they present asymmetric impacts and could give raise to shifts in the structure of balance sheets and interbank markets.“

The scenarios presented are based on a study by [Adalid et al. \(2022\)](#). The authors always assume that part of the digital euro balances come from cash holdings that have been converted into

¹²[Bellia and Calès \(2023, p. 19\)](#) point out that the "Large demand" scenario described by [Adalid et al. \(2022\)](#) would lead to a complete substitution of bank deposits by digital euros in several member states.

digital euros. In this respect, the maximum amounts held in digital euros do not correspond to the withdrawal of bank deposits. However, as explained above, the online digital euro is more of a substitute for bank deposits. Accordingly, the effect on profitability is likely to be stronger in the case of full substitution from bank deposits. [Bellia and Calès \(2023, p. 22\)](#) themselves write that raising the cap to around 5,000€ (including partial substitution from cash) already entails a significant negative shift in the distribution of returns on equity. [Petracco Giudici and Di Girolamo \(2023\)](#) identify significantly higher wholesale funding requirements and declines in bank lending for a 5,000€ cap (incl. partial substitution of cash).

A key cost aspect for banks that is not explicitly discussed in the studies mentioned above is the interest costs that result from substituting low-interest demand deposits with a reduction in interest-bearing reserves or higher refinancing at the central bank.

The deposit rate for central bank reserves is currently 3.75%, while overnight bank deposits in the euro area bear interest of around 0.2% (ECB Statistical Data Warehouse as of July 2023). Banks currently pay interest of 4.25% on refinancing with the central bank. Based on these values, various scenarios can be analyzed for the euro area with regard to the substitution of bank deposits to the digital euro and their impact on banks (table 3):

Scenario	Substitution of bank deposits (in bn. euros)	Costs for banks (in bn. euros)	Costs in relation to capital (in %)
Moderate demand	278	9.87 – 11.82	0,36% – 0,44%
Large demand	3127	111.01 – 132.90	4.11% – 4.91%
Capped scenario 3k	1028	36.49 – 43.69	1.35% – 1.62%

Note: The scenarios presented are based on [Adalid et al. \(2022\)](#). As explained above, [Adalid et al. \(2022\)](#) assume that part of the substitution to the digital euro takes place from cash holdings. Since we assume that the online digital euro is a substitute for bank deposits, the values in the first column of the table correspond to the sum of substitution from banknotes and bank deposits in [Adalid et al. \(2022\)](#). The "Moderate demand" scenario assumes a predominant use of the digital euro as a means of payment. With approximately 342 million citizens in the euro area, this corresponds to a substitution of about €810 per person (278€ billion / 342 million citizens). The "Large demand" scenario assumes the use of the digital euro as a means of payment and store of value. This scenario corresponds to a substitution of around 9,140€ per person. The "Capped scenario 3k" assumes an upper limit for the digital euro of 3,000€ per person and a substitution of the same amount per person.

Table 3: Scenario analysis for costs from substitution of bank deposits

The costs of the banks in the second column result from the loss of interest income from interest-bearing central bank reserves (3.75% deposit rate minus 0.2% interest on bank deposits). This corresponds to the lower value in the "costs" column. If the banking system does not have sufficient central bank reserves, refinancing loans must be taken out at an interest rate of 4.25%. This

corresponds to the higher value in the "costs" column. To put the banks' costs in perspective, the last column shows the costs in relation to the total capital of European banks.

For us, the **central scenario** is the "Capped scenario 3k", which assumes that all citizens take advantage of the opportunity to exchange bank deposits of 3,000€ for the digital euro. For this scenario, the costs for banks due to lost interest income or interest costs due to refinancing loans could amount from 36.5€ billion to 43.7€ billion. In terms of euro area banks' capital, this is between 1.35% and 1.62%. If higher deposits were possible ("large demand"), losses could reach a magnitude of almost 5% of capital. As interest income/costs represent regular payments, these costs are incurred annually and may also increase depending on the development of interest rates in the euro area.

4.4 Costs for the retail sector

As in the existing system, merchants are to pay a fee to the payment service providers for customer payments with digital euros. In addition, the conversion and maintenance of the payment terminals as well as the accruing license fees will lead to one-time and regular costs ([European Commission, 2023a](#), p. 3).

Since a compulsory acceptance of the digital euro is predominantly to be enforced for the retail sector, the [European Commission \(2023b, p. 47\)](#) provides in its regulation for a limitation of the fees for digital euro payments:

„Legislative safeguards should prevent merchants from being overcharged by intermediaries if they are obliged to accept digital euro as legal tender. On the one hand, PSPs would be able to charge merchants for using digital euro acquiring services. On the other hand, legislative safeguards could avoid excessive charges for merchants potentially resulting from the fact that merchants would be legally obliged to accept digital euro as legal tender and hence have little negotiating power vis-à-vis the PSPs that provide digital euro acquiring services.“ ([ECB, 2023c](#), p. 6)

Specifically, payment service provider fees are to be determined as follows:

„Any merchant service charge or inter-PSP fee shall not exceed the lowest of the following two amounts: (a) the relevant costs incurred by payment services providers for the provision of digital euro payments, including a reasonable margin of profit; (b) fees or charges requested for comparable digital means of payment.“

This arrangement may result in the payment service provider fee being less than the relevant costs and a reasonable profit margin. In addition, the fees of the payment service providers are also to

be used for **transfers to the banks** in order to compensate them, as it were as issuers, for the costs of account management:

„It is therefore proposed that PSPs charging fees to merchants for digital euro acquiring services should compensate the PSPs offering free services to customers by paying an inter-PSP fee.“ (ECB, 2023c, p. 6f)

This is to ensure that issuer banks have the same incentives to propagate the digital euro as they do for their other business:

„PSPs distributing digital euro to private individuals should have a similar level of economic incentive to do so as for other comparable electronic payments.“ (ECB, 2023c, p. 6)

This raises the question of whether payment service providers, who may not even be able to cover their costs with the fees and still have to cede part of them to the issuers, are at all prepared to establish and operate a communication system for the digital euro.

4.5 Ecological costs

The ecological costs arising in particular from the energy requirements of the systems operating in parallel should not go unmentioned. The ECB was initially aware of this problem:

„A parallel infrastructure would also run counter to the aim of issuing a digital euro in order to improve the cost and environmental footprint of payments.“ (ECB, 2020, p. 34)

Today, that no longer seems to matter.

4.6 Overall view

Since a functioning infrastructure already exists for payments within the euro area, the establishment of a new, parallel infrastructure leads to additional fixed costs for the development of the new infrastructures and ongoing costs for their maintenance. For a given volume of transactions by private households, the introduction of the digital euro will therefore increase overall information and transaction costs.

It would only be possible to reduce costs in payment traffic compared with the status quo if providers currently demanded excessive margins due to insufficient competition and if these could be reduced by **additional competitors**. However, this is unlikely. New competitors would require considerable investment to build up the necessary Europe-wide infrastructure. These investments would then be offset by limited revenue potential from the specified fees, which would also have

to be shared with banks. It would therefore be more profitable for new competitors to establish themselves in the existing system. It illustrates the difficulties of establishing oneself in the European market of payment service providers, that there is hardly any competition for the major credit card companies and PayPal so far and that joint European initiatives, such as the European Payments Initiative (EPI), have remained unsuccessful so far. Obviously, such a solution has not proved sufficiently attractive so far.

Nor is it apparent that the establishment of the digital euro, with its high fixed costs, could prove to be a catalyst for more competition in European payment system. The ECB's hope that the digital euro could contribute to greater strategic European autonomy (ECB, 2020, p. 3) is therefore unlikely to be realized.

It remains a superficial view when the ECB states that there should be no cost to users for opening and maintaining digital euro accounts. In a market economy, additional costs have to be borne by suppliers and consumers. If these costs are incurred directly by traders, they will be reflected at least partly in higher prices for goods.

Attempting to limit costs by capping payment service providers' fees may end up with no provider being found for this task at all. The ECB may force the digital euro on banks and retailers, but it is not in a position to compel payment service providers to do so.

Higher costs for consumers and retailers could only be avoided if it were possible to offload all costs to the issuer banks. However, these would then have no incentive whatsoever to encourage their customers to open a digital euro account. Since the banks are ultimately the point of contact for those citizens who have an interest in a digital euro account, the ECB would risk that this would significantly damage the spread of the digital euro. With the negative effects on banks' earnings and liquidity, there would be negative effects on bank lending. In the end, households and companies would have to bear the costs of the digital euro via higher lending rates and lower deposit rates.

5 The regulatory dimension: the ECB's relationship with commercial banks

5.1 Where is the market failure?

From a regulatory perspective, the introduction of the digital euro would represent a **paradigm shift in the relationship between the central bank and the commercial banks**, to which a histori-

cal dimension must be attached. Traditionally, the central bank's direct contact with non-banks was limited to cash. This is made available to the market by the central bank as a monopolistic provider.

With accounts denominated in digital euros, the ECB would for the first time enter into **direct competition with commercial banks**. For commercial banks, opening and maintaining accounts for private individuals is an essential part of their business model. Competition between the ECB and the commercial banks is particularly questionable from a regulatory perspective because the costs of a digital euro account are not to be determined by the market. Rather, regulation (article 17, [European Commission \(2023b, p. 47f\)](#)) should require banks to provide all account management free of charge. As already mentioned, the ECB's argument that there are no costs for using cash is not valid. Ultimately, the banks are being forced by the ECB to engage in a **dumping competition** between their own accounts and the digital euro accounts.

Using the **double waterfall functionality**, a bank customer could settle all transactions via his digital euro account without having a credit balance on this account. All the necessary waterfall transactions ("funding" and "defunding") would have to be carried out by the commercial banks free of charge. They would then only be left with the option of covering their costs via high fixed fees for the traditional bank account, which will remain necessary for most citizens despite the digital euro account.

From a regulatory point of view, any expansion of government activity into the realm of the market presupposes the existence of a "**market failure**". This is usually caused by negative **externalities**, which mean that pricing does not include all the costs of creating a product. For example, the pricing of CO_2 can be justified by the fact that the costs of environmental pollution in the energy sector would otherwise not be taken into account.

Given the far-reaching implications of the digital euro, it is surprising that the ECB has not yet explicitly addressed the issue of a market failure in the area of payment transactions. Nor is there any evidence of such a failure at present. An unsuspecting observer of this is Fabio Panetta, who has so far driven the development of the digital euro in his role as ECB Executive Board member. He made the following statement in 2018:

„But the set of tools that permit almost frictionless and instantaneous payments is already large: today we can make a digital payment by wire transfer (through online banking), with credit or debit cards, using PayPal or Apple pay (to name just a few); we can do it via computers, smartphones or smartwatches, by simply putting our wrist close to a point of sale. Competition in the supply of payment services is already high, and the efficiency of the system will increase

with the introduction in many jurisdictions of instant payments – yet another alternative to cash. From this vantage point the advantages of a CBDC are at best unclear: its potential benefits in terms of improving the ease of transactions are probably insufficient to justify the involvement of central banks in an activity that is well served by private suppliers.” (Panetta, 2018, p. 5)

A similar finding is made by the Bank for International Settlements (BIS, 2020, p. 16), which can be regarded as the bank of central banks:

„Today, vast sums flow within and between economies every day using the arrangements already in place. With a mandate for stability, central banks’ introduction of CBDC should complement these preexisting systems. In broad terms, these pre-existing domestic retail payment systems work well. In the jurisdictions of the central banks contributing to this report, the current systems offer low-cost, fast and safe payments domestically through a mix of commercial banks, other payment service providers and cash.”

In the absence of market failures in other countries that could justify the establishment of a Central Bank Digital Currency (CBDC), Christopher Waller, a member of the Board of Governors of the Federal Reserve, has concluded the following:

„After exploring many possible problems that a CBDC could solve, I am left with the conclusion that a CBDC remains a solution in search of a problem.” (Waller, 2021, p. 4)

In the absence of a diagnosis of market failure, there is thus no justification from a regulatory perspective for the far-reaching intervention in the **commercial banks’ business model** that would be associated with the establishment of the digital euro.

This also applies to the intervention in the **business model of retailers**, who were previously not subject to any state regulation with regard to their payment methods. Article 7 (European Commission, 2023b, p. 42) of the regulation now obliges retailers to accept the digital euro without being able to exclude this through their general terms and conditions, as was previously the case with cash.

5.2 The need for a "monetary anchor": the ECB’s macroeconomic rationale

The fact that there is no convincing microeconomic justification for the establishment of a digital euro can ultimately also be seen from the fact that the ECB (and also the Commission) justify its necessity with a **macroeconomic argument**:

„The lack of a widely available and usable form of central bank money technologically adapted to the digital age could also diminish trust towards commercial bank money, and ultimately

towards the euro itself. Trust towards commercial bank money relies on the possibility of depositors to convert at par their deposits into central bank money with legal tender, which currently is only available in the form of cash. Lacking a form of a central bank money that can be used in the digital economy and is convertible at par with commercial bank deposits may undermine the monetary anchor role of central bank money, weakening financial stability and monetary sovereignty in the EU.” (European Commission, 2023b, p. 1)

According to this, the digital euro is necessary to safeguard financial stability and monetary sovereignty in Europe. The problem, however, is that the ECB has so far failed to explain these fundamental interrelationships and, in particular, the function of the "monetary anchor" in greater detail.

One can distinguish between three different roles of a "monetary anchor":

- An anchor for **balances held at commercial banks**.
- An anchor that ensures the **central bank’s control over the financial system**.
- An anchor that secures the **use of the national currency as a unit of account**.

5.2.1 Anchor for balances at commercial banks

Fabio [Panetta \(2021\)](#) described this anchor function as follows::

„Convertibility into central bank money is therefore necessary for confidence in private money, both as a means of payment and as a store of value.”

This is fundamentally true, as commercial bank balances contain a legally binding promise of redemption in cash (= central bank money). Today, it would already not be technically easy to withdraw very large cash holdings from bank accounts, especially if very large numbers of depositors were trying to get their hands on their money at the same time in a banking crisis. It could therefore be argued that the convertibility of bank money into central bank money would be strengthened by opening up the possibility of exchanging bank balances for digital balances at the central bank.

However, the planned design of the digital euro would do justice to this concern only in a very inadequate way:

- A **very low ceiling** for digital euro balances is incompatible with the principle of convertibility
- Convertibility is primarily about the **store of value function**. It would therefore not be necessary to develop solutions for a digital euro as a means of payment.

- It would also have to be justified why the principle of convertibility should not also apply to the **corporate sector**, which, according to current plans, is not allowed to hold any digital euro balances at all.

From this perspective, the ECB's monetary anchor argument is inconsistent with its planned institutional design of the digital euro.

5.2.2 Central bank control over commercial banks

As shown in figure 1, payments from a bank A to a bank B cause bank A's central bank balances to decrease. If bank A lends on a large scale, payments by its borrowers to other banks cause bank A's central bank balances to decline steadily over time. An individual bank may now try to compensate for the loss of reserves by taking out money market loans from other banks. If the entire banking system extends a lot of loans, the loss of liquidity results from customers holding cash and the obligation to keep a certain percentage of deposits at the central bank (minimum reserve).

Reserve requirements would remain in place even if **cash holdings tended toward zero** because of the **minimum reserve requirement** and the banks' need to maintain a transaction cash balance at the central bank. While the reserve requirement ratio in the euro area is currently only 1%, it could be set arbitrarily higher if cash holdings were to dwindle. Thus, the digital euro would not be needed to create demand for central bank money even if there was no more cash at all.

The decisive factor for the central bank's control over the banking system is thus that the latter requires additional central money for its lending, which is identical to its money creation. The **relevant monetary anchor** for control over credit creation is thus the **central bank deposits of the commercial banks**, which are provided by the central bank as the monopolistic provider. Central bank balances of private individuals in the form of a digital euro are not required for this purpose.

5.2.3 Anchor for securing the national currency as a unit of account

With **Facebook's** announcement of the creation of a global private currency with **Libra (2019)/Diem**, central banks had to ask themselves whether there was a danger that this would jeopardize the function of national currencies as a unit of account. **Brunnermeier et al. (2019, p. 28)** described this fear as follows:

„The most important consequence of a system based on digital platforms may be that agents begin to write contracts in a unit of account specific to a platform rather than the central bank's

unit of account. A change in the unit of account convention may become more likely with a large technological change that eliminates the use of cash and shifts economic activity towards platforms with their own units of account."

In the meantime, however, it has become clear that this is precisely why Libra/Diem has been a **misconstruction** because it wanted to create a payment system that did not use the existing currencies, but a **system specific unit of account**. Those responsible recognized this mistake and changed the design so that Libra/Diem balances denominated in the national currencies would also be possible (€-Libra, \$-Libra,...).

The fact that even this design change could not save the concept was due to a **second design flaw**. Unlike PayPal, for example, Libra/Diem transactions would have only been possible if a corresponding **credit balance within the system** was available. This meant that the possible uses were too narrowly conceived from the outset.

History shows that currency units do not change easily. They are like a **common language** (Issing, 1999) and therefore have high persistence tendencies. As the introduction of the euro has shown, switching to other or new currencies results in considerable transaction and information costs.

High inflation rates are therefore bound to occur if private individuals switch to using currencies other than the national one. As experience in high-inflation countries shows, the U.S. dollar is then generally used as the unit of account ("dollarization"). Its unbroken dominance is reflected not least in the stablecoins, which are all denominated in the U.S. dollar.

This form of "monetary anchor" thus ultimately depends on the monetary policy of a central bank. It is up to the central bank to ensure that its currency is used as a unit of account for pricing and in private contracts by keeping inflation rates low. The digital euro could not contribute anything significant to this.

5.3 No binding safeguarding of the upper limits

The upper limit for holding the digital euro is of fundamental importance for the relationship between commercial banks and the central bank. So far, we have assumed - in line with the statements of the ECB and its representatives - that a relatively low upper limit will be set for the digital euro.

However, this is not fully guaranteed. In the decisive articles of the proposed regulation, a cap is neither mandatory, nor is it specified at what level and with which instruments it is to be enforced.

Article 15, paragraph 1 reads:

„With a view to enabling natural and legal persons to access and use digital euro, to defining and implementing monetary policy and to contributing to the stability of the financial system, the use of the digital euro as a store of value may be subject to limits.“ (European Commission, 2023b, p. 46)

It should be noted that this is not a requirement, but an **option**: *„may be subject to limits“*.

Article 16, paragraph 1 ("Limits to the use of the digital euro as a store of value") describes the procedure required for the implementation of the limitation:

„For the purpose of Article 15(1), the European Central Bank shall develop instruments to limit the use of the digital euro as a store of value and shall decide on their parameters and use, in accordance with the framework set out in this Article.“ (European Commission, 2023b, p. 46)

The regulation only speaks of "**instruments**" but not of quantitative ceilings. The ECB could therefore also try to limit the holding of digital euro balances as a store of value by **imposing prohibitive negative interest rates**. With zero interest in the normal case, as required by regulation, negative interest could be applied to balances above a threshold. An equivalent model with differentiated interest rates has been proposed by Bindseil (2020).

In paragraph 2 of this article, the parameters for the use of the instruments are designated as follows:

„The parameters and use of the instruments referred to in paragraph 1 shall: (a) safeguard the objectives set out in Article 15(1), in particular financial stability; (b) ensure the usability and acceptance of the digital euro as a legal tender instrument; (c) respect the principle of proportionality.“ (European Commission, 2023b, p. 46)

With these soft criteria, the ECB could raise the ceilings significantly at any time. The Bank of England, for example, proposes **an upper limit of between GBP 10,000 and GBP 20,000**:

„We propose a limit of between £10,000 and £20,000 per individual as the appropriate balance between managing risks and supporting wide usability of the digital pound. A limit of £10,000 would mean that three quarters of people could receive their pay in digital pounds, while a £20,000 limit would allow almost everyone to receive their pay in digital pounds.“ (Cunliffe, 2023)

In principle, the ECB could even dispense with ceilings altogether. This would significantly change the impact on the business model of commercial banks. Although the regulation stipulates that

digital euro balances should be interest-free (article 16, paragraph. 8, [European Commission \(2023b, p. 47\)](#)), the advantage of the digital euro as an **absolutely safe store of value** could then become much more important, since many sight deposits are held interest-free.

In case of a broad cap or even the absence of such a limit, the risk of disintermediation of the banking system would increase considerably. In principle, such a process would require the ECB to increase bank refinancing accordingly. For the banks' earnings situation, this would result in the already mentioned unfavorable effect that they would have to substitute non-interest-bearing sight deposits for interest-bearing refinancing by the ECB.¹³

Moreover, it is a concern that a strong tendency toward disintermediation makes commercial banks highly dependent on the central bank. In principle, the central bank can increase the outflow of bank deposits in digital euro accounts by providing higher refinancing loans to commercial banks. However, depending on the availability of "eligible collateral," a situation may arise, at least for individual banks, in which they are no longer in a position to extend additional loans to the private sector due to insufficient collateral.

5.4 Regulatory conclusion

Neither the microeconomic nor the macroeconomic approach reveals any convincing justification for the necessity of a digital euro. Thus, there is no regulatory justification for the ECB's advancement in the banking sector. This is all the more alarming because the ECB not only wants to offer an alternative product to the bank account, but also wants to launch it on the market at conditions that do not cover costs. At the same time, there is no justification for the ECB to force retailers to use the digital euro as a payment solution.

It is particularly problematic that the Commission's regulation does not provide for a legally binding upper limit for the amount of digital euro balances. The soft wording of the regulation thus gives the ECB considerable leeway to expand its influence on the European banking system at its own discretion, to the detriment of the commercial banks. Under the current circumstances however, this seems unlikely.

But one cannot rule out the possibility that the ECB's already unjustifiable advancement of the banks' field of business is only a first step. In its current form, regulation does not stand in the way of this.

¹³This effect is not taken into account by [Bellia and Calès \(2023, p. 20\)](#): „[...] we are not considering any intervention by the ECB to match the reduction in bank deposits, in the form of liquidity injection or collateral posted to obtain additional (cheaper) funding from the ECB.“

6 Risks for the financial system

The risks of the digital euro for the stability of the financial system depend to a large extent on how the limit on holding balances as a store of value is set. Without a limit, the risk of a **"digital bank run"** would be considerably greater than it is now, as it would be much easier for depositors to transfer a bank balance digitally to the central bank than to exchange it for cash at the bank counter or ATM. In a run situation, where many depositors withdraw funds at the same time, the problems are particularly high.

The dangers of a digital deposit withdrawal have been exposed by the collapse of the Silicon Valley Bank in March 2023. For this reason, the ECB has emphasized the need for instruments to limit the volume of digital euro holdings from the very beginning. This was implemented accordingly in the regulation, but without, as already mentioned, naming the instruments specifically.

The ECB could try to limit the attractiveness of the digital euro by **negative interest rates**. As mentioned, the regulation stipulates that the digital euro should not bear interest. However, this would not preclude the ECB from charging negative interest rates. These could be implemented in the form of "fees", as it was observed in recent years at commercial banks. However, this would be of little help in a crisis situation. If depositors fear immediate losses on their bank deposits, an annualized interest rate disadvantage of one or two percentage points would not stop them from shifting their funds to the ECB. It would also not be helpful in such a situation if the ECB were to respond with significantly negative interest rates on digital euro balances.

If digital bank runs are to be avoided, a fixed and low **quantitative ceiling** is thus a basic prerequisite.

With a **gradual buildup of balances** and a low holding limit, there should be no stability risks. Banks could initially reduce their reserves and close the remaining refinancing gap by borrowing from the central bank.

A situation could prove problematic in which, as we expect, demand for balances in digital euro accounts remains very low. This could change abruptly if there is instability in the banking system. Although depositors with balances below 100,000 euros are protected by deposit insurance, the existence of digital euro accounts could cast **doubt on this protection**. The fact that the ECB provides its citizens with an alternative form of bank deposits could lead to traditional bank

deposits being considered inferior by citizens. This would likely affect banks in particular, which are already suffering from outflows by larger depositors. In a crisis situation, the existence of the digital euro could thus lead to an **additional destabilization** of the banking system due to purely psychological effects.

Under the conditions of the monetary union, additional destabilizing effects are to be expected. As the **euro crisis** in 2010/12 showed, major shocks can lead to a country's membership in the monetary union being called into question. In such a situation, a particular incentive would arise for citizens to exchange their traditional bank balances for digital euro balances. If the exit actually takes place, the traditional balances would be redenominated from euros into the national currency by a currency law. The digital euro Balances would continue to be denominated in euros as a liability of the European Central Bank. They would therefore provide protection against the "**redenomination risk**" that played a significant role in the euro crisis. Thus, in a crisis situation, depositors could take advantage of the maximum scope for digital euro balances. Especially if the use of these accounts has previously been very low, this would result in an abrupt loss of liquidity for the banks of such a member state. In an already unstable situation, the availability of the digital euro would prove to be a crisis amplifier.

7 Is there an alternative?

With the enormous costs, the barely discernible benefits for Europe's citizens, the serious regulatory concerns, and additional risks to financial stability, the question is whether there is a simpler solution to strengthen Europe's' position in dealing with the dynamic processes in the global payments landscape.

When it comes to the dominance of U.S. payment platforms, the Commission is right to problematize Europe's lack of strategic autonomy and resilience::

„Moreover, a digital euro would support open strategic autonomy by creating a new payment scheme that would be resilient against potential external disruptions.“ ([European Commission, 2023b](#), p. 9)

However, this raises the question of whether the digital euro actually offers the best solution for this. Given the high infrastructure costs that would be required for a communications system for the digital euro with only a low level of participation initially, it is hardly likely that a new European provider will take on this task. Rather, it is to be feared that the digital euro will end up being managed by U.S. providers, who would be most capable of doing so with their highly

developed communications networks.

The chances for a competitive European payment platform would be much greater if it would not be burdened with the ballast of a multitude of low-end digital euro Accounts and their complex waterfall functionalities. Or put differently: If it has not been possible so far to find a common solution via the European Payments Initiative, it will be even more impossible to do so under the precarious conditions of the digital euro.

The ECB would therefore be well advised to devote the same effort it is putting into the digital euro to pushing forward an integration of existing national bank payment systems via the **European Payments Initiative**.

The experience of other countries illustrates that it is perfectly possible for central banks to act as coordinators to promote integrated national digital payment systems. In most cases, they have succeeded in achieving rapid market take-up, thus creating a counterweight to global payment platforms.

Examples of this include:

- **Brazil:** Pix with the Banco Central do Brasil (BCB) as initiator and owner of the system ([Bofinger and Haas, 2022](#)).
- **Thailand:** PromptPay, developed and supervised by the Bank of Thailand.
- **Singapore:** PayNow, a real-time payment network managed by the Association Bank of Singapore (ABS) and overseen by the Monetary Authority of Singapore (MAS).
- **Sweden:** Swish, launched in 2012 by six major Swedish banks in collaboration with Bankgirot and the Swedish Central Bank.
- **India:** Unified Payments Interface, a real-time payment system developed by the National Payments Corporation of India (NPCi) under the direction of the Reserve Bank of India.

Another example of success is the private Swiss payment system TWINT.

In addition, there are already numerous bilateral initiatives that link these national systems for **cross-border payments** ([Economist Intelligence Unit, 2022](#)).

A characteristic feature of these systems is the use of **QR codes as a payment instrument**. Since the initiative here comes from the payer's bank („direct credit“), the intermediary function of the credit card companies becomes superfluous. The answer to the dominance of U.S. payment platforms is therefore not primarily the creation of a European credit card company, but the integration of

national bank payment systems using QR codes as a payment instrument.

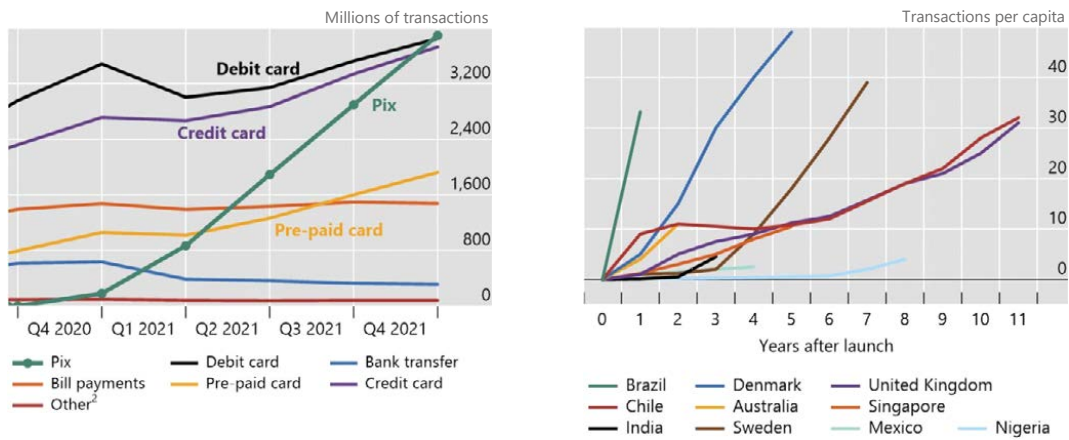
A common feature of all these systems is that they do not require a digital payment object (**Central Bank Digital Currency**; CBDC) issued by the central bank. It can thus be concluded that the ECB's insistence on the digital euro ultimately blocks, rather than promotes, the creation of a competitive European solution for payments. The dominance of the U.S. credit card companies is thus not weakened, but perpetuated.

The following sections provide a brief overview of two relatively new and highly successful payment systems: Pix in Brazil and TWINT in Switzerland. While Pix is a system where the central bank is actively involved in the set-up and ongoing operation, TWINT is an example of a private payment system that has asserted itself against international competition.

7.1 The Brazilian payment system Pix

The Pix system is an instant payment system created, owned and managed by the Central Bank of Brazil (BCB). Participation in Pix is mandatory for financial institutions if, for example, they have more than 500,000 active customer accounts. In this way, the BCB ensures that a large part of the population has access to Pix. This mandatory participation ensured that a critical mass of adoption was quickly achieved once Pix was released (Duarte et al., 2022). Institutions that offer transaction accounts but are below the threshold can voluntarily choose to participate in Pix. Although Pix has only been operational since late 2020, it already has 114 million individual users, representing 67% of Brazil's adult population, and is used by 9.1 million businesses, or 60% of firms with relationships to the national financial system (Duarte et al., 2022).

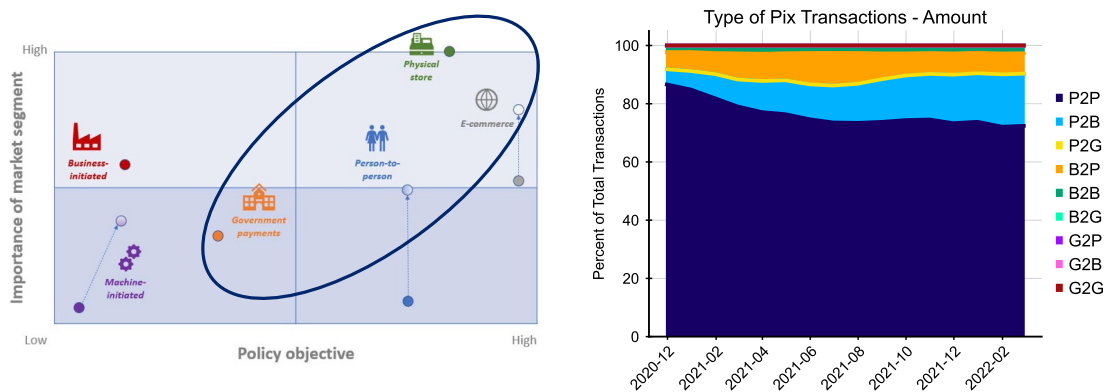
All Pix payments are processed through earmarked accounts held by direct participants in the system in a centralized framework at BCB. Since Pix is processed through users' transaction accounts, all users are already identified by their banks or payment service providers when they use Pix. This ensures compliance with regulatory requirements such as KYC (know-your-customer regulation). A bank account is not required to use Pix, as transaction accounts can be offered by other financial institutions and FinTechs. Pix has quickly surpassed other payment systems in terms of number of transactions (Figure 9a). The growth in transactions per capita since launch has been significantly higher than other major payment systems (Figure 9b).



(a) Use of Pix for transactions compared to other payment systems (b) Post-launch comparison of Pix transactions per capita with other major fast payment systems

Figure 9: Pix transactions. (Source: Duarte et al. (2022, p. 5f))

Payments in Pix are mainly triggered via smartphones and QR codes. Users can register up to 5 Pix keys, such as an email address, phone number, or tax number, linked to their transaction account to easily receive payments. To avoid sharing personal information, users can also register an anonymous random key consisting of 32 characters. Pix payments are free of charge for individuals. Legal entities may be charged a fee for making and receiving a Pix payment.¹⁴ By controlling the fees for its payment system, BCB has created a payment system that significantly reduces payment costs for merchants in Brazil. Figure 10 shows that Pix is mainly used for P2P and P2B transactions, which are also the main use cases for the digital euro.



(a) ECB (2022b, p. 5)

(b) Share of transactions by type (Source: BCB)

Figure 10: Prioritization of digital euro use cases and share of transactions by type for Pix payment system; P=Person, B=Business, G=Government

¹⁴0.01 BRL per 10 transactions for payment service providers (Duarte et al., 2022)

The advantage of the central bank operating such a payment system is described by [Duarte et al. \(2022, p. 4\)](#) as follows: *“By directly operating such a system, the central bank can define and enforce rules that govern the platform, including on costs, use of data and other technical standards.”* The launch of Pix contributed to financial inclusion, as 50 million people conducted Pix transactions who had not made account-to-account transfers in the 12 months prior to the launch of Pix ([Duarte et al., 2022](#)). The user perspective was central to the development of Pix:

“The BCB approached Pix product development with a user-centric perspective, focusing on the concrete needs of households and businesses in their payment habits, and gaps in the current system. Working together in the Pix Forum, the BCB and private PSPs defined a range of use cases, such as P2P, P2B, electronic bill pay and deferred payments to meet specific needs” ([Duarte et al., 2022, p. 7](#))

[Duarte et al. \(2022, p. 6\)](#) also note a focus on usability as a success factor: *“The ease of use for individuals and the multiplicity of use cases may be one reason why actual use has increased quite rapidly – to 33.2 transactions per capita, a record among peer jurisdictions.”*

7.2 The Swiss payment system TWINT

A similar success can be observed in Switzerland with TWINT. The main difference is that TWINT is a purely private payment system. It was created by private commercial banks and PostFinance, which is owned by Post AG, a company owned by the Swiss government.

TWINT is a mobile payment solution that enables payments without system-specific payment objects, although users could also opt to use system-specific deposits on their TWINT account. Similar to PayPal, TWINT can be linked to a user’s own bank account or credit card, for example. A payment is then triggered via the TWINT app and the amount is debited from the bank account. TWINT can be used for P2P transactions, at the point-of-sale or for online transactions. TWINT primarily works with QR codes for transactions, as they can be used by anyone and are not dependent on any specific hardware. This is especially helpful for merchants who do not have a payment terminal. TWINT is integrated and optimized for the needs of Swiss citizens, merchants and retailers. For example, it enables payments at parking meters, the purchase of public transport tickets and integration with other providers, such as for ordering groceries or taking out new insurance policies. In 2020, TWINT processed over 70% of all mobile transactions in Switzerland and is regularly used by 45% of all citizens. Alternative mobile payment systems such as Apple Pay or Google Pay have significantly lower shares ([Graf et al., 2022](#); [BearingPoint, 2021](#)). TWINT is thus *“by far the most prevalent solution”* ([Swiss National Bank, 2021, p. 33](#)) of all installed mobile payment apps in Switzerland. It is thus an impressive example of a domestic payment system that

has successfully asserted itself against the dominant international payment systems. Figure 11 provides an overview of the development and spread of TWINT.

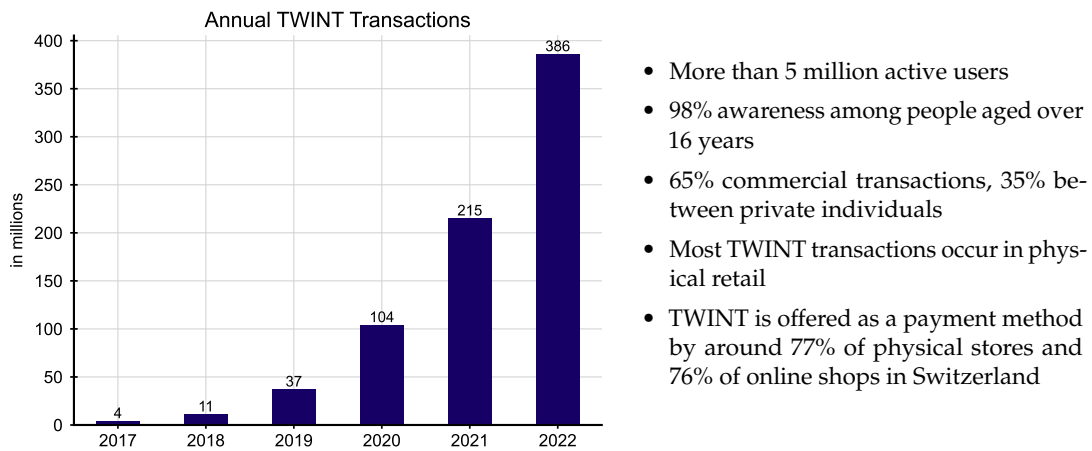


Figure 11: Development and distribution of the TWINT payment system (Source: TWINT)

8 Summary

With the digital euro project, the ECB has embarked on a risky path. It is pursuing a strategy in which it is unclear which problems are to be solved and what concrete goals are to be achieved. The ECB has developed a blueprint for a European payment system without having reached a binding agreement with the main players, the private payment service providers, on their role. The ECB wants the digital euro to be successful, but not too successful:

„We do not want to be ‘too successful’ and crowd out private payment solutions and financial intermediation. But the digital euro should be ‘successful enough’ and generate sufficient demand by adding value for users.“ (Panetta, 2022)

In doing so, the ECB is not relying on the digital euro being attractive enough to hold its own in the payment systems market. Instead, it is imposing a solution on commercial banks that has self-destructive elements for them. It deprives retailers of the leeway to decide for themselves which means of payment they will accept. The dirigiste approach also affects payment service providers, who, in case of doubt, are not even allowed their costs and a reasonable profit margin. However, this is where the limits of the regulatory options become apparent. Since the payment service providers cannot be forced to provide a communication system for the digital euro accounts, the ECB may end up without a main actor. From a regulatory perspective, the whole concept suffers from the fact that the ECB has so far not bothered to diagnose a clear market failure. The

attempt to claim the need for a "monetary anchor" instead is not very convincing.

In general, we see the most likely scenario as one in which citizens' interest in the digital euro will be extremely low. The special character of "central bank money" can hardly be communicated to the public and is ultimately irrelevant in view of the deposit insurance. The ECB would then find itself in a situation that would damage its reputation: it would have built up an infrastructure at very high cost that would ultimately hardly be used.

However, this could prompt the ECB to raise the ceilings in order to unleash greater demand for the digital euro as a store of value. As described, the ECB - in the current version of EU regulation - has considerable room for maneuver in this respect. The substitution of low-interest sight deposits by lower reserve holdings or larger refinancing loans would, as shown, have a significant impact on banks' earnings at higher volumes. In addition, higher ceilings would have a destabilizing effect on the financial system in crisis situations.

For citizens, this means that they will have to bear the costs of the digital euro twice. Since the ECB will have higher costs, the central banks will be able to distribute fewer profits to the national treasury. Since the additional costs for the private sector will ultimately be shared between suppliers and demanders, paying in the euro area will not become cheaper, but more expensive. In addition, the burden placed on banks by the administration of digital euro accounts and higher refinancing costs may also make borrowing more expensive for citizens and companies alike.

Finally, the from the perspective of European sovereignty desirable solution of a European payment system that can prevail over U.S. payment platforms is hindered rather than promoted by the insistence on the payment object of a digital euro.

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