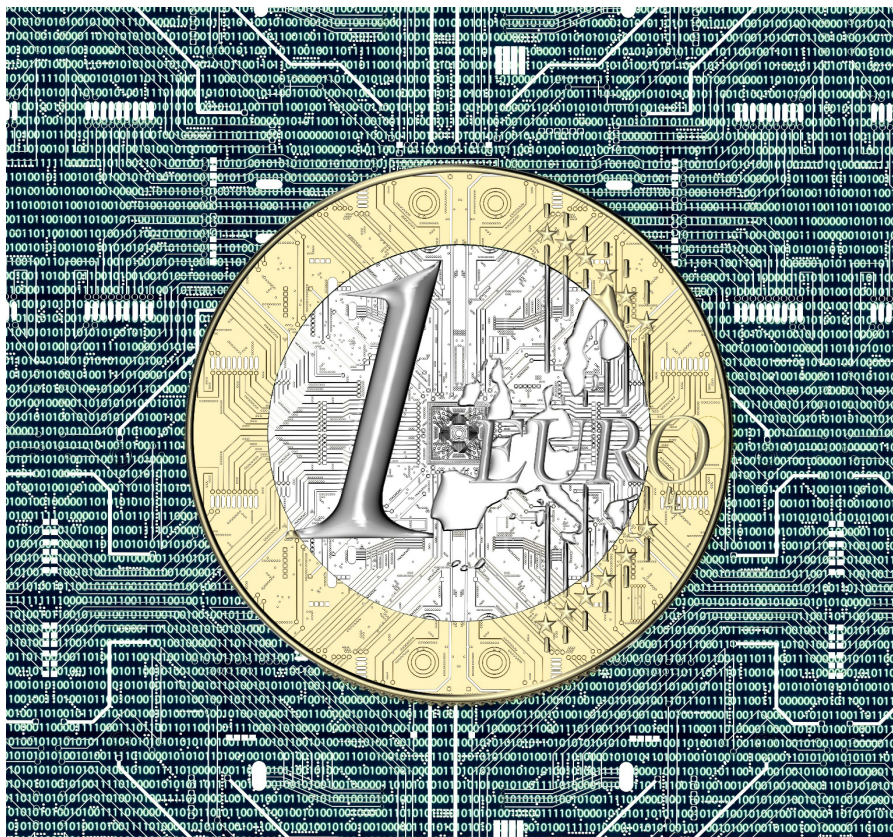


The digital euro: policy implications and perspectives



The digital euro: policy implications and perspectives

Abstract

The study identifies the fundamental rationale for a possible issuance of a digital euro: to preserve the role of public money in a digital economy. It outlines the policy options, trade-offs as well as design issues that its creation would raise.

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LIST OF ABBREVIATIONS

AML/CFT	Anti-money laundering and countering the financing of terrorism
API	Application programming interface
BIS	Bank for International Settlements
CBDC	Central bank digital currency
DeFi	Decentralised finance
DFR	Deposit facility rate
DLT	Distributed ledger technology
ECB	European Central Bank
EPI	European Payments Initiative
GDPR	General Data Protection Regulation (GDPR)
KYC	“Know your customer”
MiCA	Markets in Crypto-Assets Regulation
OCA	Optimum currency area
SEPA	Single European Payments Area
SMEs	Small and medium-sized enterprises

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EXECUTIVE SUMMARY

The European Central Bank (ECB) has decided to launch a two-year investigation phase of a possible digital euro. This announcement has raised many expectations and also many questions. What would be the purpose of a digital euro? How would it work? What would be the consequences for European citizens? Would it disrupt the activities of banks? How would it concur with fundamental European Union (EU) values, such as privacy? This study aims at identifying trade-offs and main policy options and possibilities.

The digital euro project is a response to a broader change: the digitalisation of money itself. A new type of money is emerging, based on virtual units of value moving on the internet. It can be broadly thought as "digital cash". It can be stored on a mobile device or a computer. It can be instantly transferred, just like sending an email. It can be used directly to pay from person to person (peer-to-peer), irrespective of distances and borders.

The digitalisation of money brings several major transformations:

First, *money is becoming more diverse*. Money in digital form is easy to create. It can be tailored to almost any shape or usage. It can be managed through a great variety of ledgers and protocols.

Second, *money may become more segmented*. Digital money often prospers inside large "platforms" which aggregate many activities (e.g. commerce, entertainment, social media) and exploit their synergies. Those platforms tend to be organised as "closed-loop" ecosystems. The money they use and, possibly, create may not be easily transferable into other environments.

Finally, *money is becoming more competitive*. In a digital world, (almost) anybody with some expertise in cryptography and computer science can create money. Experiments in private money (cryptocurrencies) are now flourishing. Currency competition may also develop both inside and across borders, with some countries – or private operators – using their digital networks to circulate their currencies in other jurisdictions, creating so-called global stablecoins.

Some benefits of digitalisation are certain and visible. Retail payment systems have been pushed to improve and innovate. Major efforts are being made to accelerate cross-border payments and reduce their cost. In Europe, instant payments are being developed and strongly promoted by the authorities.

Other consequences will be more challenging.

For citizens, the aggregation of money and data will amplify concerns of privacy that are endemic to the digital world.

For banks, the emergence of "BigTech" as major competitors in payments (as well as deposit-taking activities) may increase their funding costs and destabilise their business model. This is not neutral, as banks play a major role in financial intermediation in the euro area and are also essential for the transmission mechanism of monetary policy.

The central policy question raised by digitalisation is the role of public money. It is issued by central banks, in the form of cash and reserves held by commercial banks. Public money is the anchor of the monetary system. Because all forms of money are ultimately convertible into public, it ensures that the currency is "uniform": all monetary instruments with the same nominal value trade at par in all circumstances. They are equivalent. Public money also provides the unit of account, which serves as a standard of value for all transactions and contracts in the economy. Doing so, it also preserves monetary sovereignty, which can be defined as the ability of governments to control the unit of account in their jurisdiction in order to manage the macroeconomy.

To fulfil those functions, public money must be present and freely available in all sectors and parts of the economy. That ubiquity is doubly compromised by digitalisation. First, if cash were to disappear, the general public would not have access to central bank money anymore and would spend their lives in a universe of totally private currencies. Second, platforms and closed-loop systems could develop without any common reference of value, which would greatly compromise the uniformity of money.

The main rationale for developing a digital euro is therefore to preserve the role of public money in a digital economy.

Should the ECB Governing Council decide to issue the digital euro, its design will involve many policy choices and trade-offs.

First on privacy. Privacy is a core value for EU citizens and a central driver of the acceptability and trust in money. Privacy, however, comes into conflict with other, equally valid, policy objectives in which the EU is also a world leader: the fight against money laundering, the financing of terrorism and tax evasion.

A second choice is about banks and their role in financial intermediation. It may be that an attractive digital euro would compete with the deposit-taking activity of banks in addition to the pressures already coming from BigTech.

A third choice concerns the place that the central bank wants to take in the economy and society. Technology and digitalisation would enable it to directly open accounts to hundreds of millions of euro area citizens. Should it consider that possibility or rather issue the digital euro in the form of a "cash-like" bearer instrument?

Finally, on monetary policy. Contrary to cash, the digital euro could be issued with an interest rate. Should that possibility be used, as advocated by many economists? Or should public digital money stay as close as possible to the characteristics of cash?

Together, those choices open the possibility of radical changes in the current monetary and financial arrangements in the euro area. They could transform the relationship between citizens and money and put the central bank in a completely different position.

There is no indication, however, that this perspective is considered by the Eurosystem or any other EU institution. The study looks instead at a solution of continuity, where the digital euro would be issued as a digital version of cash and conceived to preserve, rather than disrupt, current monetary arrangements.

Even so, the precise design will require delicate trade-offs and choices. As public money, the digital euro will have to be universally accepted and widely accessible. It should be present everywhere. On the other hand, the Eurosystem may not want to evict private money issuers (the banks) or private payment providers. It may not want to gain a monopoly or dominant position in retail payments. The digital euro will thus be placed into a strange and paradoxical position. It should be present everywhere but important nowhere. It should be successful but not too successful.

To that effect, the "specialisation" of the digital euro as a pure medium of exchange may be considered. The amounts necessary for transaction balances would be limited and therefore less disruptive. This solution would also be more advantageous from a privacy perspective, as anonymity is more justified for normal payments than for money stored as wealth.

To specialise the digital euro, the Eurosystem would have to set an acceptable level of transaction balances. Limits would have to be defined. Those limits can be set either through quantitative (ceiling) or price (tiering) mechanisms. A cap or ceiling on individual holdings is fully transparent, clear, and easily understood. Its quantitative impact can be directly assessed *ex ante*. Tiering would be based on

a different principle. There would be no hard limit, but holdings above a certain threshold would be dissuaded, for instance, through a mechanism of fees. Both solutions are differently attractive and their costs and benefits need to be carefully weighted.

While the operational case for specialising the digital euro is straightforward, the economics are more uncertain and ambiguous. Money, as a perfectly safe and liquid asset, jointly performs three functions. Separating them by design, however justified, introduces a discontinuity that may have negative side effects.

Finally, for the digital euro to produce all its expected benefits, it must develop in an appropriate regulatory environment, sufficiently conducive to the uniformity of the currency. Payments sit at the intersection of many current policies of the EU. They have a close link with money (the topic of this study). Private and regulatory initiatives are all in a state of flux. There is now an opportunity to define and shape the architecture of a unified European payments area.

1. INTRODUCTION AND OVERVIEW

On 14 July 2021, the European Central Bank (ECB) decided to launch a two-year investigation phase of a possible digital euro. This announcement has raised many expectations and also many questions. What would be the purpose of a digital euro? How would it work? What would be the consequences for European citizens? Would it disrupt the activities of banks? How would it fit with fundamental European Union (EU) values, such as privacy? These are complex issues that, ultimately, will be decided on the basis of social preferences as well as technical imperatives. This study aims at identifying trade-offs and main policy options and possibilities.

The digital euro project is a response to a broader change: the digitalisation of money itself. A new type of money is emerging, based on virtual units of value moving on the internet. It can be stored on a mobile phone or a computer. It can instantly be transferred, just like sending an email. It can be used directly to pay from person to person (peer-to-peer), irrespective of distances and borders. It can be broadly thought of as "digital cash" as envisaged by Milton Friedman more than twenty years ago (Friedman, 1999):

"... the internet is going to be one of the major forces for reducing the role of government. The one thing that's missing but that will soon be developed is a reliable e-cash, a method whereby on the Internet you can transfer funds from A to B without A knowing B or B knowing A, the way in which I can take a \$20 bill and hand it over to you and there's no record of where it came from and you may get that without knowing who I am. That kind of thing will develop on the Internet and that will make it even easier for people to use the internet. Of course, it has a negative side. It means that the gangsters, the people who are engaged in illegal transactions will also have an easier way to carry on their business."

Digital money has surfaced in a variety of contexts. WeChat's and Alipay's digital wallets have come to dominate the payments system in China. In Africa, mobile providers have launched successful money transfer services, such as Safaricom's M-Pesa. Facebook has led the development of digital currencies for social media networks, announcing plans – which were later rescinded – to issue its own currency, the Libra, a "stablecoin" pegged to a basket of official currencies. Finally, in recent years, thousands of cryptocurrencies maintained on blockchains by anonymous record-keepers have been launched.

Digitalisation is changing payments. But how far does it change money itself? There have been many phases of monetary innovation in the past. Is this one "special" and will it transform the functioning of monetary systems? Does this new wave of innovation bring a radical rupture with past monetary arrangements? Many proponents of cryptocurrencies certainly think so.

The academic and policy communities have been intensively debating this question. Over the last three years, numerous analysts and policymakers, including major central bankers, have given speeches or written books on "the future of money." This contrasts with the previous three decades, when "as economics has become more and more sophisticated, it has had less and less to say about money." (King, 2016). It also raises the question in the private-public partnership what the optimal mix between public and private money is.

From a public policy perspective, those fundamental questions about the nature of money cannot be escaped. Central banks and monetary authorities have special responsibilities. Confronted with fast and major technological disruptions, they have to determine which innovations they encourage, accommodate, accompany or, on the contrary, dissuade. They must identify which main characteristics of money have to be preserved in a changing technological environment.

This study puts emphasis on two key concepts: the uniformity of money and its role as a unit of account. These are the two components of monetary identity and sovereignty. What delimits a monetary zone, what creates monetary sovereignty and what makes an independent monetary policy possible is the simple fact that people count and pay in euros; and that euros are the same everywhere in the area, whatever their form, their location and the identity of their issuer.

As the study shows, economic forces unleashed by digitalisation naturally work against the uniformity of currency. Private issuers have strong incentives and the technical capacity to create their own differentiated, special-purpose money. The economic incentives of digital platforms push them to erect technical barriers to the interoperability of their systems. Digitalisation may therefore lead to an excessive fragmentation of the monetary space, ultimately compromising the ability of money to serve its basic functions.

Current monetary systems are held together by the public money issued by the central bank in the form of reserves (for banks) and cash (for the general public). Public money defines the unit of account: it can be supplied elastically and can be made exchangeable against all private forms of money. It serves as a bridge for converting one private money into another. It guarantees a uniform currency anchored on the unit of account. Those functions will remain central in a digital economy but more difficult to fulfil if cash disappears from day-to-day exchanges and the general public ends up living in a totally private monetary environment.

The main rationale for developing a digital euro would be to preserve the role of public money in a digital world. To the extent that money becomes digital, central bank money must be made available in digital form in all parts of the economy and society. All other (private) forms of money must be practically related to it through convertibility and interoperability. This effectively allows all payment instruments to replicate the unit of account properties of public money.

While it must be ubiquitous, the digital euro should not aim at domination. Uniformity must not be pushed to the point that it would stifle innovation and efficiency. The delicate balance between competition and cooperation with private providers of payment services must be preserved. Current arrangements based on a complementarity between private and public money have served the public well. Maintaining that equilibrium in a digital economy where scale and network effects are prevalent will involve difficult trade-offs, as well as technical choices, that are discussed in the study. All along, references to European policy objectives and values, first of all privacy, are kept in mind.

2. THE RATIONALE FOR A DIGITAL EURO

A decision by the central bank to issue a new form of money, so-called “central bank digital currency” (CBDC), would have significant implications for the financial sector, many parts of the economy and for society. It must rest on an assessment of its costs and policy benefits.

Overall, current monetary arrangements have served the public well. Retail payments in the euro area are becoming faster, cheaper and increasingly efficient. From an efficiency perspective, the need for a new form of public money - a digital euro - is not immediately apparent. There is no obvious case for a “public option” in retail payments.

Looking into the future, however, money will become increasingly digital. The private sector is clearly embracing and driving the movement. If all private money becomes digital, what should central banks do? Should they consider a future where only private money is available to the general public? Is public money essential or can we dispense with it in a digital world?

Box 1: Public versus private money, or a mix of both?

Should money be totally public, private, or a mix of both? The question has occupied economists and policymakers for many centuries. The global financial crisis and the digitalisation of money have given new arguments to supporters of either totally public or totally private monetary systems.

According to the sovereign money school of thought, money and money creation should be exclusively public. Private banks should not have the power to create money. Private money issuance is the source of moral hazard: it creates unjustified rents. It is the ultimate cause of financial instability as illustrated during the global financial crisis of 2007-2008. Those arguments were recently developed during the Vollgeld referendum in Switzerland in 2018, and supported by 24% of the population. Digitalisation has given some technical credibility to those ideas, as it is now theoretically possible for a central bank to open and manage millions of individual citizens' accounts, thus serving as a deposit bank for a whole country.

On the other extreme of the debate, followers of Friedrich Hayek (1976) advocate a fully private monetary system with no role for any central bank and public money. This movement is founded on a deep distrust of governments, suspected of a permanent inclination to debase the currency. It counts on competition between private money issuers to instil discipline and monetary stability.

This libertarian streak has been significantly boosted by digitalisation and its multiple possibilities of money creation. At its origins and roots, the “crypto” movement is anti-government. A major attraction of Bitcoin for its supporters is its “decentralised” method of consensus and a process of issuance governed by algorithm. Both allow to dispense with a central bank - indeed with any intermediary. A frequent narrative in crypto circles predicts the triumph of cryptos and the collapse of national currencies following the accommodating (non-conventional) policies conducted over the last decade.

2.1. The digitalisation of money

Most of our money, except banknotes, is already electronic. Nevertheless, advancements in digitalisation have led and will lead to transformational changes.

Technically, digital money is both an instrument (tokens stored on a mobile device or computer) and an infrastructure (the network that transfers value across space). The internet allows us to copy and transmit information with almost no costs over any distance. This creates enormous possibilities for

citizens and businesses. Easy transmission of information is good, from the perspective of money. Easy copying is not. That's why the new forms of digital money had to wait for recent progress in distributed ledger technology (DLT) and cryptography. Only since recently can such transfer of value over the internet and phone networks be made secure.

2.1.1. Digital tokens

In monetary economics¹, a "token" is an instrument representing value that can be exchanged directly, on a peer-to-peer basis, without validation by a third party. Just holding the token means that one legally possesses it. There is no need for identification and certification by any third party. Cash, in the form of banknotes and coins, is a physical token.

Technology now allows the creation of purely digital tokens. A digital token is an electronic file that embodies a specific value. It has a name attached to it. By just changing the name, the value has been transferred and a payment is made². While the principle is simple, its implementation necessitates sophisticated technologies. The possible "tokenisation" of money (and also other financial assets) may be the biggest innovation in the field of payments and finance over the last decades.

Digital tokens are easy to create. Today, practically any sophisticated software developer can issue money. Digitalisation seemingly "democratises" the monetary power. Not surprisingly, it has unleashed a wave of new private money initiatives. Today there are almost 9,000 cryptocurrencies³ with different characteristics and unequal significance.

Digital tokens are fungible, divisible, and transferable. They can be customised to any specific need. They need proper security, and must be supported by a robust legal infrastructure. But they are otherwise fully flexible. In particular, tokens can (or not) keep track of the sequence of payments (the names attached to the file). Payments can be made more or less private or anonymous.

2.1.2. Ledgers and architecture

There is, however, one important difference between physical tokens (banknotes) and their digital cousins. Digital tokens have no material existence. It is necessary that they be "registered" somewhere. There must be a designated system to authenticate the signatures. Digital money rests upon a technical infrastructure – a ledger.

In public and policy debates, digital money is frequently associated with DLT. A decentralised ledger is securely held in several simultaneous copies by many different and unrelated participants. It has to be permanently synchronised between those participants. Most digital tokens function on a blockchain, a particular form of DLT where new entries are first bundled into "blocks" and then sequentially linked to each other. The blocks form a chain. Because each block incorporates a coded summary of the entire preceding chain, the blockchain cannot be tampered with. It is immutable. It's only recently that progress in distributed ledger protocols has made it possible to securely transfer tokens peer-to-peer.

The ledger structure is extremely important for the governance of digital activities. The DLTs and blockchain open new and creative ways to manage complex systems - such as supply chains - where there is a need for precise recording of events and permanent coordination of participants. They offer

¹ On the complexity and confusion surrounding the token terminology, see Lee et al. (2020).

² "The metaphor of a coin, object, or bearer instrument living in a wallet or locally on someone's machine raises significant questions regarding technological feasibility, safety, and security. Unlike traditional money, tokens in the cryptocurrency space are not stored locally but rather on a blockchain. What can be stored locally is a private key that allows for the transfer of the tokens on the blockchain. Importantly, what is stored or possessed by the end user has consequences for how we think about bearer instruments in the digital world..." Lee et al. (2020).

³ Source: CoinMarketCap. "Cryptocurrencies." <https://coinmarketcap.com/> (Accessed 11 January 2022).

the possibility of secure, transparent and accessible storage of complex histories, such as medical records or land registers.

However, their performance as payment systems is more open to question. Decentralisation is attractive in theory but very challenging to implement in practice. A consensus must be found to validate payments between multiple actors with no time coordination and no mutual trust. As an example, Bitcoin is a monetary system that operates with full decentralisation on a blockchain. Bitcoin is very innovative in its “consensus” method, through which all participants to the network have the capacity and right to validate transactions. It is also very secure: all “hackings” of Bitcoin have occurred in peripheral systems. The price to pay, however, is a very slow flow of transactions. Bitcoin is hardly “scalable”. It is also extremely energy-intensive.

Decentralisation is an organisational choice, not a technical necessity. Tokens can work perfectly well on more centralised infrastructures. From a monetary perspective, what matters most is not the technical infrastructure but the underlying economic architecture, which determines the tokens' regime of issuance and the foundations of their value.

From a user perspective, all tokens look the same. They can all be spent or transferred through identical processes and applications, such as digital wallets. But, depending on how they are issued, they are in fact very different monetary instruments. They can be denominated, or not, in official currencies (such as the euro or the dollar). They can be attached to an existing deposit in a bank, or totally independent. Tokenisation is compatible with a great diversity of monetary architectures. Currently, three types of models dominate the digital landscape.

First, in open banking applications, tokens are just “mirrors” of an existing bank deposit. They are just tools to make payments by moving money from one account to another. They are the digital equivalent of debit cards. Such applications can be developed by bank themselves or independent payment service providers.

Second, at the opposite extreme, cryptocurrencies are completely new monetary objects. They are not related to a bank account. They are denominated in specific units of account, unrelated to existing currencies. They are private monies with no backing. They are not a claim on any natural or legal entity. There is no historical precedent for this type of digital private money. Most cryptocurrencies are decentralised. They are designed to function efficiently on an open network with no trust between participants. They dispense with any financial intermediary.

Third, in between the two extremes, stablecoins are a new category of digital currencies that is expanding fast. Coins are deemed “stable” because they are backed by other assets held by the issuer⁴. Most are backed by non-crypto assets. In effect, they are digital representations of existing fiat currencies. The two largest are Tether (USDT) and USD Coin (USDC), denominated in dollars, and are predominantly used to facilitate trading, lending, and borrowing of other digital assets. More exotic forms exist, where the stablecoin is backed by other cryptocurrencies or assets. Stablecoins raise many issues of market integrity and financial stability that are beyond the scope of this study. Most of them involve some maturity and liquidity transformation and are therefore exposed to the risk of runs.

A specially interesting case of digital coin was the (now abandoned) project of Libra. Libra was a new digital currency developed on the Facebook network (of now Meta), with potentially more than 2 billion users. It was to be denominated in its own unit of account. It was backed by a basket of official

⁴ Some promoters of stablecoins are working on projects where currency issuance would be regulated by a sophisticated algorithm. The objective would be to expand and contract the supply so as to maintain a stable price. While the idea is seductive, the implementation may be difficult. In particular, it is not clear how the protocol could force the contraction of supply in case the stablecoins depreciate excessively.

currencies. Libra illustrates the potential of private digital currencies to overhaul and disrupt the existing monetary order. Libra was subsequently revamped as stable coin under the new name Diem.

2.1.3. The benefits of digital innovation in money

Many benefits of digitalisation of money are certain and visible.

For the general public, a digital token stored on a mobile phone closely mimics the characteristics of cash, without any of the physical constraints linked to weight or distance. Digital money can be securely and instantly exchanged on a peer-to-peer basis, including cross-border and at very long distances. Sharing bills and sending money to family members far away, has - or will - become commonplace. Digitalisation is a powerful tool for financial inclusion as, in many emerging countries, mobile penetration is significantly higher than bank penetration.

The rise of digital money has spurred a wave of innovation in retail and cross-border payments. Under the pressure of competition, retail payment systems have been pushed to improve and innovate. In Europe, instant payments are being developed and strongly promoted by the authorities.

Potential benefits may even be greater for corporates and financial intermediaries. In a digital world, “there is a computer in the middle of each transaction” (Varian, 2014). Interactions between machines and algorithms will increasingly shape business activities and relations. Digital money offers the possibility to transfer value between computers in extremely short periods of time, with no settlement risk. Dispensing with a third party may offer huge benefits. Tokens are ideal payment instruments to execute so-called “smart contracts”, which are automated financial operations governed by a predetermined protocol (generally on a blockchain). At the moment, such automated transactions are largely confined to the crypto world but will certainly extend, in the future, to a large part of production and trade activities.

Digital money obviously finds numerous specific applications in finance. Wholesale digital tokens may be used in the future as settlement assets for real time payments between banks and financial intermediaries. Stablecoins have developed as the main medium of exchange for financial transactions that take place inside the crypto sphere. They form the basis for fast growing applications regrouped under the name of “decentralised finance” (DeFi). The term broadly refers to financial activities (lending, arbitraging, derivatives, collateralisation) operated without any intermediaries through automated protocols and smart contracts. Many of these developments raise policy concerns (about financial stability, market integrity and investor and consumer protection) that are beyond the scope of this study⁵.

2.2. The new and disruptive features of digital monetary systems

2.2.1. The unit of account and a uniform currency

People who live in the euro area share one common characteristic in their economic life. They count, pay, contract, and set their prices in euro. The euro is their only standard of value. They do not use any other unit of account. Furthermore, without any possible doubt, there is only one “euro”. It always has the same value whatever its form, its location and its issuer. The currency is uniform. Together, uniformity and the unit of account form the basic components of a cohesive and functional monetary system.

⁵ See President’s Working Group on Financial Markets, the Federal Deposit Insurance Corporation and the Office of the Comptroller of the Currency (2021).

A “uniform currency” is a major objective for central banks. Modern monetary systems rest on a competition between different private exchange media. Most euros are created and issued by private banks; most retail payments are operated by private providers. Their numbers will increase and diversify in a digital world. If the currency is uniform, all monetary instruments with the same nominal value will be exchangeable at par in all circumstances. They are perceived by the public as equivalent. By contrast, in a fragmented monetary system, different types of currency become imperfect substitutes, creating a fundamental uncertainty about the value of money. Each would carry a specific and idiosyncratic risk that would necessarily be reflected in the “exchange rates” that would arise between different types of domestic money. In effect, the monetary system would be transformed and behave more like the broader financial system where the creditworthiness of every single instrument is constantly re-assessed and priced.

After more than a century of successful central banking, the uniformity of currency tends to be taken for granted. It should not be. In the past, uniformity was compromised by differences in intrinsic values of monetary objects as well as physical distances. In the “Free Banking Era” in 19th century United States (US), banknotes were not traded at the same value everywhere. In the future, technological barriers will challenge uniformity. It may also be endangered by financial instability. There were periods in the recent history when a “re-denomination risk” materialised between different parts of the euro area, temporarily introducing frictions in money transfers and potentially compromising the equivalence between bank deposits in different countries.

The unit of account may be the most important function of money. It serves for quoting prices, for denominating debt and for negotiating contracts. It is a basic convention of society, such as the language and the standards for measurement. In modern economies, the central bank defines and controls the unit of account. Ultimately, a euro is a liability of the Eurosystem with a nominal value of 1€. If the currency is uniform, all monetary instruments and prices are attached, one way or another, to that standard of value.

A uniform currency and the control of the unit of account are jointly necessary to ensure the implementation of monetary policy and preserve monetary sovereignty.

Central banks can act on the economy because they set the interest rate attached to their own liabilities. Changes in the policy rate are transmitted across a whole spectrum of financial and credit markets. That process is most efficient when arbitrage is easy and frictionless. It may not be possible if different forms of money have different – or uncertain – nominal values.

Monetary sovereignty can be defined as the ability of central banks to control the unit of account in their whole jurisdiction. Monetary sovereignty is lost when citizens start using a foreign (or private) currency in their daily life to quote prices, wages and financial contracts. In that scenario, the economy is “dollarised”. Domestic monetary and financial conditions are determined by an authority (foreign or private) that issues the unit of account. Domestic monetary policy becomes powerless.

2.2.2. Digital monetary systems are less uniform

Uniformity and the unit of account have been naturally preserved over the last century of central banking. In the future, digital monetary systems may evolve in ways that would fragilize the existing architecture and monetary arrangements.

In a digital world, two economic forces naturally work against the uniformity of currency: the infinite possibilities of differentiating monetary instruments; and the tendency of private money networks to organise into closed ecosystems.

a. Programmable and special-purpose money

Digital tokens are very versatile. They can exist in many forms. Creating differentiated tokens is very easy. Issuers can tailor the forms of money to their specific needs. In the current parlance, money can be made "programmable". There are two possible meanings attached to this formulation.

First, programming can be inserted into the use of money. Payments can be managed by smart contracts, i.e., algorithmically triggered by events or conditions. With programmable wallets, it will be possible to make contingent payments that only occur in certain events, and to have fully automated settlements between devices in a world of the internet of things (see Bundesbank, 2020). Automated payments are going to develop.

Second, programming can directly affect the nature – and value – of the monetary unit itself. For instance, money may be issued with a date of expiration beyond which it is not valid anymore; like digital coupons used by city authorities of Hangzhou in China. It can be restricted for a particular use, like food stamps. It might be tempting to make exceptional welfare payments in a money with an expiration date, so as to ensure that they are spent, not hoarded, and maximise their stimulus impact. Theoretically, governments with autocratic or moralistic tendencies can limit the use of those welfare payments, prohibiting the purchase of alcohol or leisure goods, making them closer to food stamps. The technical possibilities are almost infinite.

But what is the value of a money with an expiration date, or limited use? Will it be traded as a discount? How can it be transferred? It is clear that uniformity of money has been lost. In reality, programmable money is an oxymoron. Strictly speaking, it is not money.

b. Digital platforms as closed monetary systems

Digital platforms are multi-sided markets or, in common parlance, "ecosystems" that aggregate a multiplicity of activities within which consumers, merchants, and service providers interact. The economic logic of platforms is to create and develop complementarities and links between those different activities. They have economic incentives to erect technical barriers to the interoperability of their systems, limit their connections with other parts of the economy and operate as closed systems (Brunnermeier and Payne, 2022).

Platforms could lead to an excessive fragmentation of the monetary space. Money can play an important role in the business model of platforms. A shared (form of) currency strengthens those links; it keeps the platform growing and profitable. In particular, money gives access to data. BigTech platforms have an edge in data collection through their ability to combine payment data with other data sources. This induces a self-enforcing mechanism. Platforms that offer their own payment services are able to collect even more data, which improves their recommender systems, which makes more attractive for customers to join them.

To further lock-in customers and enlarge their footprint, platforms have the technical capacity to create their own differentiated digital money. This evolution is occurring most spectacularly in China, where fintech companies such as AntFinancial and Tencent have moved aggressively into payment services and e-money. They have developed state-of-the-art mobile payment systems while simultaneously aggregating many diverse activities. This model may also expand to other parts of the world.

In sum, platforms may want to become autonomous monetary systems, currency areas of a new kind: *digital currency areas* (Brunnermeier et al., 2019). They are not defined, as in the traditional literature on optimum currency areas (OCA), by the commonality of macroeconomic shocks and the degree of factor mobility (Mundell, 1961). They are based on digital interconnectedness. Because participants share the same form of money, payments inside the area are easier and trading frictions are lower than with

outside. For people who use the same form of money, price transparency is greater, price discovery easier, and so is the netting of payments.

2.2.3. Digital monetary systems are more competitive

Digitalisation creates the possibility of increased currency competition. Whether such competition materialises will depend on regulation and, more generally, the interaction between public policy, private attitudes, and technology. Currency competition could develop across three dimensions:

a. Competition between private mediums of exchange

Competition in payments is good for the economy and for citizens. Cryptocurrencies and digital money have already produced significant innovations and improvements, especially in cross-border retail payments, where inefficiencies are still high. They acted as a catalyst for change, like Napster did for the music industry a few decades earlier. Consumers will benefit from faster, cheaper, and more efficient payment services. And those will contribute further to the financial integration in Europe.

b. Competition between private and public unit of accounts

Beyond payments instruments competition may extend to the unit of account, thus compromising monetary autonomy and sovereignty. This evolution is more uncertain and speculative but, as the Libra/Diem experiment has shown, it cannot be ruled out in a digital world where money creation has become technically easy. Cryptocurrencies have their own unit of account and the ambition, for some, to displace official currencies. For platforms, having a currency with its own unit of account maximises the lock-in effect. It creates an exchange risk for those who want to exit. It also generates seigniorage.

c. Competition between different national currencies

Unless designed otherwise, digital money is naturally cross-border. If not constrained, it naturally penetrates other countries' territory. Digitalisation has raised concerns of increased currency substitution and competition between countries.

The euro seems largely immune to such currency competition. However, the threat to the efficiency of monetary policy could be real if, in the future, global stablecoins denominated in a foreign currency expand and develop.

Not all countries are equally affected by current technological changes or equally exposed to such competition. Digitalisation may serve as a vehicle for the internationalisation of some currencies. It may help them to quickly gain international acceptance and status. And, symmetrically, other countries may be exposed to new forms of "digital dollarisation," depending on their monetary regimes, the openness of their capital account, and their regulation of payments and the internet.

Obviously, international currency competition and substitution is nothing new. Digitalisation will, however, give it a new dimension and impetus. It will also create a new dynamic interaction between public authorities and private actors. Some countries may rely on private operators - using their digital networks to circulate their currency in other jurisdictions. The Libra/Diem project launched by Facebook (now Meta) in 2019, and since strongly rebutted by the authorities, has acted as a wakeup call. It demonstrated the technical feasibility of a completely new, cross-border monetary system, based on its own unit of account, with potentially 2 billion participants over the world.

Over time, as it transforms domestic monetary systems, digitalisation may reshape international monetary relations and the international monetary system as well. In that world, private money ceases to be a complement to public money and becomes a competitor, to the point of potentially evicting it from the economic space.

2.2.4. Digital monetary systems are more private

In a digital world, (almost) anybody with some expertise in cryptography and computer science can create money. Not surprisingly, experiments in private money are now flourishing. The issuance of private money has been strongly reinvigorated by technology. Digitalisation has revived a libertarian school of thought that deeply distrusts governments and central banks. Almost 9,000 cryptocurrencies are currently in use, some of them significant, many other marginal. Innovation goes further with attempts to build up new monetary systems, created by tokens moving around a specialised network of users.

A full digitalisation of retail payments would lead to the elimination of cash, which is currently the only public money accessible to all. Should cash disappear, citizens would lose access to public (central bank) money. There would in effect no longer be a functional legal tender, with the operation of the monetary system turned over to private entities. Absent access to public money the general public is effectively locked into private money. The perception that there is no access to safe liquid assets backed by the state could undermine confidence.

Money would no longer be a physical manifestation of sovereign authority. Citizens would no longer have any visible symbol linking money to the authorities and to the central bank. Symbols are important for money, as illustrated by the debates around the euro banknotes when the single currency was created. Connecting the central bank to money might also be important for the effectiveness of the central bank's communication.

2.3. The digital euro: preserving public money in a digital world

There is a paradox of public money. It is hardly visible in everyday life, except for small and decreasing amounts of transactions in cash. It is hardly identifiable either. Citizens perceive money as a whole. They don't see the distinction between bank deposits – which are private money - and cash, which is issued by the central bank. Yet, the character of public money makes it absolutely central and essential to the stability and functioning of economies. Because it is invisible and not detectable, the benefits attached to public money tend to be taken for granted. But they have to be preserved in a new environment. This is the main rationale for exploring the issuance of a digital euro.

Box 2: CBDC initiatives around the world

The past few years have seen an exploding interest in CBDC by central banks all over the world. As the private issuance of a number of cryptocurrencies has raised questions on many aspects of the future of monetary policy, central banks have started exploring CBDC as a concrete option for the years to come.

Following this heightened interest, a CBDC Tracker has been established by the Atlantic Council to systematically track CBDC-related initiatives around the globe. A few key statistics (referring to the time of writing) is collected are summarised in Table 1. Nine countries – Nigeria, The Bahamas and the Eastern Caribbean Currency Union (Dominica, Montserrat, Grenada, Saint Vincent and the Grenadines, Saint Lucia, Antigua and Barbuda and Saint Kitts and Nevis) – have completed the launch of a full-fledged digital currency for retail purposes.

14 countries, among which China, South Korea, Singapore, Malaysia, Israel and Sweden, have instead inaugurated pilot projects on CBDC. In particular, the People’s Bank of China has progressed quickly in rolling out digital yuan trials in several provinces across the country.

Furthermore, 16 countries and currency areas are developing and testing CBDC technology at an early stage, and among them the euro area with its ECB-sponsored projects and analyses on both retail and wholesale CBDC. 41 countries are instead conducting preliminary research on the details and possible effects of the adoption of a sovereign digital currency.

Overall, 87 countries – representing over 90% of global GDP – are currently involved in CBDC explorative projects, a testament to the growing salience of the issue on central banks’ policy agendas.

Table 1: CBDC initiatives around the world

CBDC status	Number of countries
Launched	9
Pilot	14
Development	16
Research	41
Inactive	7
Cancelled	2

Source: See [Atlantic Council CBDC tracker](#) [Accessed on 13 January 2022]

2.3.1. Is there a “business case” for the digital euro?

The launch of CBDCs is frequently advocated on pure efficiency grounds: to improve the functioning of payment systems. However, central banks have no comparative advantage in managing retail payments and client relationships. This objective may be best achieved through proper regulation and incentives aimed at the private sector.

Proponents of such an expansion in central banks’ role mainly refer to three arguments.

First, the need to stimulate competition and innovation in payments. Competition in payments is important and difficult, especially in the digital age. It can be best stimulated through specifically designed policies and instruments. As for innovation, recent evidence points to a very dynamic private

process. New digital currencies, including cryptocurrencies, in particular stablecoins, have revealed latent aspirations for distant, instant, and peer-to-peer payments. To some extent, they are forcing other actors to adapt. Their business model may raise serious issues of competition and integrity.

Second, the necessity to foster financial inclusion. More than one billion people in the world (millions in the euro area) do not have a bank account. They mostly come from the poorest of households. Many of those unbanked persons have a mobile phone. Mobile payments work for financial inclusion. Instant and easy identification is possible through phone numbers. In case welfare payments are necessary (as was the case during the COVID-19 crisis), governments can reach those segments of the population that need it most. However, is direct public intervention necessary to create and foster mobile payments? In many cases, including in poor and emerging countries, private initiative has provided an efficient service. M-Pesa, in Kenya, has 50 million customers, most of them unbanked. If and when necessary, a proper mix of regulation and incentives applied to private operators could achieve the necessary result.

Finally, the need to improve cross-border retail payments. Technically, domestic payment systems are often not interoperable between countries. Delays are longer; compliance risks and costs related to anti-money laundering and countering the financing of terrorism (AML/CFT) are typically higher. Small payments (such as remittances) are most penalised. Some private digital currencies now offer new solutions that "bypass" existing bank-based payment systems. However, sustainable and scalable solutions will require significant investments to be coordinated between countries. This is a case where public intervention might help. The joint creation, by several countries, of interoperable CBDCs could build the necessary infrastructure and offer a backbone, fostering further private developments.

2.3.2. The current complementarity between private and public money

In contemporary monetary systems, public and private money do not compete with each other. They are complements. Authorities are generally happy to entrust the private sector (the banks) with running payment systems and allocating credit. They accept that banks manage and create most of the money existing in the economy. Whatever the instrument and infrastructure, ultimately, a non-cash payment is a transfer of a deposit in one bank account into another bank account.

But that organisation is only made possible because public money is there, in the background. It performs two essential functions.

One is invisible: the central bank issues reserves, which are liabilities held by commercial banks in accounts at the central bank. Reserves are used as a settlement instrument between banks. Because they are claims on the central bank, they are generally considered as a "superior" form of money (in any case superior to any claim on the banks themselves). Because banks can settle between themselves in full confidence and security, the general public is able to transfer money from one bank to another with the same confidence and security. All deposits are considered as equivalent forms of money outside of crisis times. Without public money (the reserves), the situation would be different. Counterparty risks between banks would periodically arise, casting doubts on their mutual solvency, impeding or paralysing interbank settlements. Deposits could not be transferred across different banks, and their equivalence would be broken.

The second role performed by the central bank, the issuance of banknotes or "cash", is more apparent and familiar. While quantitatively of small importance, cash is crucial for the stability and confidence in money. People have the right to exchange their deposits into cash whenever they wish, without restriction or loss of value. If the public is confident that this right can be exercised with no condition, the two forms of money - private and public - are perceived as equivalent. Bank deposits are equivalent to cash. Or, in broader terms, private money is equivalent to public money.

2.3.3. The digital euro as an anchor

The central policy question raised by digitalisation is the role of public money. The technological evolution leads to a reduction of the role of cash and, ultimately, its disappearance for the general public. That would mark a fundamental shift in existing monetary arrangements. There is no recent historical precedent for a situation where people live their lives in a fully private monetary environment. The main rationale for developing a digital euro would be to prevent this evolution. To the extent that money becomes digital, central bank money must be made available in digital form.

Central bank money is of superior quality because it does not depend on the solvency of a private issuer. It is supported by the power of governments to tax and, in most countries, by legal tender. It provides the ultimate settlement asset between banks. It also defines the unit of account. As long as all forms of money are ultimately convertible into public money, it ensures that the currency is uniform: all monetary instruments with the same nominal value trade at par in all circumstances. They are equivalent.

To fulfil those functions, public money must be present and freely available in all sectors and parts of the economy. The ubiquity of central bank money is essential to its role as anchor. All households must be given the opportunity to hold and use central bank money. The same is true for corporates and financial institutions. As digitalisation progresses, private payment and settlement networks and mechanisms will develop for good efficiency reasons, with, in some cases, special-purpose tokens acting as “local” media of exchange. To fulfil its functions, central bank money must be able to penetrate all those “cracks” in the productive and financial system. That can only be achieved if it exists in a form adapted to the needs of a digital economy.

Box 3: Scenario with only private money

In current monetary arrangements, central bank money plays a crucial role, because it is safe. As long as it is perceived as safe, it can be elastically supplied, serve as a settlement asset and store of value, and provide the standard of value (unit of account) for the economy. By contrast, left to its own dynamics, private money is unstable. Its nominal value is contingent on the perceived solvency of its issuer and therefore subject to changes in perceptions and multiple equilibria.

But what if private money could be made “safe” for the general public through a mix of public regulation and support? There would seemingly be no need to issue a digital public money.

Several tools are available to authorities to enhance the safety of existing private money (bank deposits):

- In effect, deposit insurance – to the extent that it benefits from public support – already plays that role.
- So do the lender of last resort and refinancing activities of the central bank, which preserve the uniformity of money by ensuring that deposits are unconditionally transferable between banks.
- Finally, banking regulations aim at ensuring that banks remain solvent in all circumstances, therefore indirectly supporting the value of deposits. Regulators provide for quick and orderly resolution of banks (with insurance of deposits) in case insolvency nevertheless occurs. It also *de facto* limits banks from issuing too much deposits.

It could be argued that the combination of those three tools – tight bank regulation with regulators that can shut down banks, lender of last resort, and deposit insurance – makes it possible to have a system in which 100% of the money held by the general public is issued by private banks and nevertheless considered as safe. This is certainly an issue worthy of further research.

In addition, one could allow new forms of private money in form of stablecoins issued by private entities. In addition to the above regulations, interoperability regulations across various platforms and ledgers are necessary to ensure the right convertibility, acceptability, and portability (Brunnermeier and Payne, 2022).

However, because there is no precedent in modern history without public money, it would be dangerous to base public policy on that assumption. In such an environment, what would determine perceived safety for the public is unknown. With no public money to turn to, runs on banks may become more frequent. They could occur from one bank to another, or from the euro to foreign currencies. In that case, it is certainly preferable to have a digital euro as a safe haven instead of a foreign currency or a cryptocurrency. Ultimately, recurring episodes of instability may become self-fulfilling and undermine the confidence in the whole monetary system.

Finally, there are periods when monetary accommodation is necessary and not spontaneously undertaken by private money issuers. In some exceptional circumstances, monetary authorities need to keep the option of “bypassing” financial intermediaries and directly supply public money to the economy.

3. PUBLIC POLICIES AND THE DIGITAL EURO

3.1. The digital euro and privacy

3.1.1. Privacy and payments

Privacy is a core value for European citizens. In the EU, privacy is considered not only an individual right, but also a common and social good. Personal data protection is among the prerogatives covered by the EU Charter of Fundamental Rights. The EU has taken a leadership role in the world with the passing, in 2016, of the General Data Protection Regulation (GDPR), specifying a unified set of rules for companies and public authorities. The GDPR has proven an essential policy tool to safeguard individuals' fundamental rights when interacting with technology in the single digital market.

The importance of privacy for citizens is reflected in a survey conducted by the ECB in 2021. Among the requested features of a potential digital euro, privacy ranked highest: for 43% of respondents, as compared to 18% mentioning security and 11% the ability to pay across the euro area (Eurosystem, 2021).

There is a fundamental logic to this attachment to privacy in payments. Paying is one of the most frequent acts in everyday life. In autocratic societies, government surveillance of payments is a privileged way to monitor private and social interactions. Apart from governments, people also want to be protected from other people when they transact with them. For individuals, the history of payments reveals an enormous amount of information about their habits, preferences, medical situation and way of life. It is a legitimate aspiration to have this information protected: first, from those with whom one transacts; and, second, from the third party which manages the transaction. In sum, privacy gives money part of its value. It empowers individuals to engage in activities and exchanges that they may not undertake otherwise (Kahn, 2018).

Therefore, pursuing privacy as a feature of money is certainly a valid policy objective. Should a digital euro be launched, its privacy features will be a major driver of its acceptability and trust.

3.1.2. Privacy and other policy objectives

Privacy, however, comes into conflict with other, equally valid, policy objectives. The EU is also a world leader in the fight against money laundering, financing of terrorism and tax evasion. Regulations implementing those objectives (AML/CFT) may limit cash usage: in most countries, regulations mandate that large cash transactions be reported (with significant differences across Member States). "Know your customer" (KYC) regulations, under certain circumstances, allow professionals to reveal the identity of counterparties or account holders with the aim of fighting money laundering.

The landscape is changing fast as digital payments introduce additional complexity in the policy trade-off. Digitalisation both threatens and potentially enhances privacy. Depending on social norms and organisation, privacy in digital payments may yield good or bad results. The availability of transaction data can have a positive social value if it allows, for instance, to make better and faster predictions on the economic activity, better recommender systems, or to substitute collateral and make credit more accessible. On the other hand, the business model of platforms rests upon the exploitation of payment data for private scoring and other uses. Payment information can be very valuable to a variety of actors, especially if combined with other data and exploited with artificial intelligence and machine/deep learning algorithms. In autocratic political systems, these same data may be used for social control.

In this new digital space, cryptocurrencies derive part of their popularity from the anonymity they confer – be it for legal and illegal reasons. Over the last years, several successive generations of

cryptocurrencies have been designed with the purpose of achieving an ever-increasing degree of anonymity.

3.1.3. Policy challenges for the digital euro

For the digital euro, the challenge raised by privacy can be simply described. Cash is private by nature. It guarantees third-party anonymity and it leaves no traces. Regulation is necessary to limit the privacy it confers. For a digital currency, the logic is inverted. Transactions in digital money are recorded on a ledger – they necessarily involve a third party. No public digital currency will automatically and spontaneously ensure the same level of privacy as cash. For a digital euro, privacy has to be decided, organised and embedded into its design. It will result from fundamental political and social choices.

Privacy will certainly be a major driver of the attractiveness of a digital euro. Privacy regimes applicable to cash provide a useful benchmark. They will certainly serve as a mental reference for many users. In a digital world, however, additional considerations also matter. Amongst all the providers of payment services, the central bank is the only one which has no interest in exploiting personal data for profit purposes. It can provide citizens with a “privacy safe haven” which mirrors and parallels the monetary safe haven that public money brings. In digital environments that become increasingly intrusive, it would certainly be a useful social function – and give public money a valid comparative advantage.

It should be noted that an important difference exists between the concepts of anonymity and privacy. Privacy requires that both the nature and participants to a transaction remain unknown. Anonymity is less demanding: while the identity of the parties is protected, the transaction itself can be observed and recorded. That difference may be essential in designing a CBDC. Anonymity may go a long way in meeting citizens' concerns while preserving other objectives of public policy (such as AML/CFT).

Finally, one cannot overemphasise the importance of the governance of privacy. Whatever regime is finally chosen for the digital euro, it will rely upon technical and instructional guarantees⁶. Those must be fully credible and trusted by the population if the confidence in the currency is to be ensured and maintained.

The technology offers many degrees of flexibility in deciding and implementing privacy/anonymity options. Privacy and anonymity can be differentiated according to the operational level. For instance, privacy may be assured for offline transactions below a certain threshold. Anonymity can be guaranteed *vis-à-vis* public authorities and not private operators – or the reverse. Depending on countries, it is possible that preferences differ, as the population may trust more the government or the private sector to preserve confidentiality of their data. An architecture that gives maximum flexibility while fully compliant with regulations is more apt in ensuring trust.

3.2. The digital euro and financial intermediation

The issuance of a digital euro may have important consequences for financial intermediation and financial stability. Concerns have been expressed that, once the general public has easy access to the central bank balance sheet through the digital euro, instability will arise for the deposit-taking activities of banks and destabilise their business model.

However, the digital euro is only one of many changes that will impact banks' business model in the era of digitalisation. Its effects are likely to be small when compared to the magnitude of the disruption that BigTech will bring in the area of payment apps and digital money. BigTech and stablecoins may entail substantial losses of funding for banks, depending on how those actors manage their liquidity.

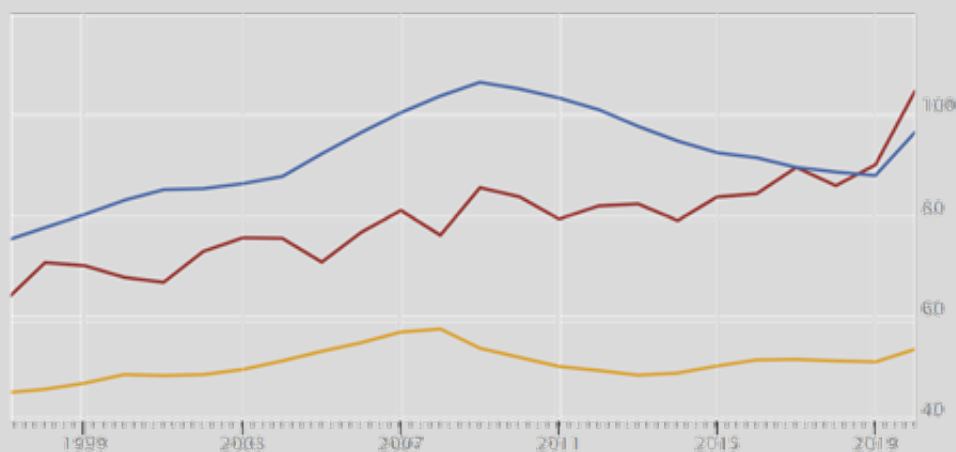
⁶ See ECB (2019) for a discussion on the technical aspects of anonymity in CBDCs.

This being said, banks play a major role in financial intermediation in the euro area. As compared to the US, where capital markets are predominant, bank credit is more important to the financing of productive activities, especially for small and medium-sized enterprises (SMEs). Banks are also essential in the transmission mechanism of monetary policy. In the future, increased competition in payments and deposit activities will produce important benefits for consumers. It will also inevitably alter banks' business models. Authorities will have to decide how far to go in other changes overhauling the European model of financial intermediation. The introduction of the digital euro should be seen in that broader perspective.

Box 4: Firms' financing in the euro area and US

Firms' financing operations in euro area and the United States have historically been carried out through different mixes of bank-based and market-based approaches. In Europe, banks have played a predominant role for channelling funds to firms and borrowing to households, while the US has witnessed the prevalence of capital markets as instruments for channelling credit. Figure 1 depicts private non-financial sector borrowing from banks as a fraction of GDP. The blue line depicts the series for the euro area, while the yellow line is the series from the US. The rest of the developed world is also more bank-dependent, as shown by the series for G20 countries in red.

Figure 1: Bank lending to private non-financial sector as percentage of GDP for the euro area, G20 and US



Source: Bank for International Settlements.

SMEs are more bank-dependent than large corporations. Over time, fintech financing will gain an increasingly important role in funding SMEs – a development that will emerge independently of the introduction of the digital euro. To the extent that the introduction of a digital euro could interact with the bank-reliant financing model, a careful monitoring by the relevant supervising authorities is required.

3.2.1. Digitalisation disrupts banks and financial intermediation

Banks bundle together three different functions, essential to the working of a modern economy. They manage deposits and payments; they grant and allocate credit; and, in the process, they create (private) money in the form of bank deposits. Being able to combine all these three functions makes the banking industry a central piece of every modern financial architecture. The general trend of digitalisation of money has the potential to disrupt and challenge the banks' business model.

First, banks will face new and strong competition from BigTech and platforms. Those actors are mainly interested in one function of money: to make payments. They regroup this function with other activities developed in synergy, such as e-commerce or social messaging. Payments, because they are an essential activity of social life, contribute to keeping all the functions linked together in the ecosystem of the platform. Above all, payments give access to data, which can then be exploited in other lines of business. Payments become unbundled from other aspects of money and banking – such as the store of value – and re-bundled with very different economic functions.

Second, increased competition in payments may exert pressure on the deposit-taking and funding activity of banks, ultimately compromising their ability to grant credit or increasing its cost for borrowers.

Finally, in the longer run, digitalisation may lead to an inversion in the current industrial organisation of financial intermediation (Brunnermeier et al., 2019; Landau and Genais, 2019). At the moment, banks are the main point of contact with their borrowers and debtors. The preeminence of payments may reverse that implicit hierarchy. A new organisation could emerge with payments at its core and all other financial activities organising themselves around that function. Consumers' point of contact would be the entity that owns the payments platform rather than a bank. Financial services such as credit or asset management and insurance would be subordinated to payments. In this new type of financial hierarchy, banks could be replaced by fintech subsidiaries of payment systems. The two payment giants in China – Ant Financial and Tencent – prefigure that evolution.

3.2.2. Possible effects of a digital euro

There is no doubt that a totally safe and liquid monetary asset is an extremely attractive medium of exchange and store of value, especially if offered in unlimited quantities. Depending on its design, significant amounts of deposits and liquid investments could shift to the digital euro. There are two dimensions to this disintermediation risk: (1) a “structural shift” could occur from private deposits to the CBDC, fragilizing the funding of banks; and (2) runs on banks may become easier and more frequent.

a. Structural shift away from bank money

First, it is possible that the general public will permanently shift part of its transaction balances away from bank deposits and into the CBDC. The potential amplitude of such a shift is unknown. It would have two cumulative effects: banks would lose funding; and they would have to compete more for deposits, increasing the cost of their resources. Depending on the magnitudes, there could be a significant reduction of banks' profitability, and of their ability to distribute credit.

The effects of structural shifts and runs to central bank money can be alleviated or compensated by the central bank itself, through credit and refinancing given to banks, in its function as a lender of last resort. More broadly, Brunnermeier and Niepelt (2019) have shown that it is possible to devise a set of compensating policies that would make the introduction of a CBDC fully neutral on the macroeconomic equilibrium and the allocation of resources (although it would necessitate a great deal of fine tuning). This is discussed in Section 4.3.

b. Increased frequency of runs

Bank runs could become more violent and frequent as digitalisation makes it easier to convert one form of money into another. Bank runs would be enabled further by digitalisation, which by design is intended to facilitate electronic transactions. Once central bank money becomes available in digital

form, the frictions that are associated to the manipulation of cash would disappear. Any doubt or concerns about a bank could translate into massive movements of funds.

It is possible to take a benign view of those risks. Most of the runs occur between banks themselves. They may create localised tensions but do not threaten the financial system as a whole. Banks have always been subject to deposit flights. Digital runs from one bank to another have already occurred in recent times. Runs are the unavoidable counterpart of the convertibility of deposits into public money. They can indeed be characterised as a pathology of convertibility. They cannot be eliminated without restricting convertibility itself. Finally, supposing depositors want to run from banks, in the absence of a digital euro, they would be incited to move to foreign currencies, if those were available in digital form.

Box 5: Banks, deposit taking and credit

Franchise value as a rationale for bundling:

A rationale for bundling lending and deposit taking within the banking sector is to give banks market power in providing transaction services and so extract charter rents from setting deposit interest rates below the policy rate. Although it may seem counterintuitive to view bank rent extraction as desirable, the literature (summarised in Brunnermeier and Payne, 2021) has suggested several potential benefits to giving banks a positive franchise value.

1. *Limiting excessive risk-taking.* Banking activities are difficult to monitor and bank managers have limited liability for their losses. This has frequently led to excessive risk-taking. One way to discourage risk-taking is to promise banks future rents through their deposit franchise so that banks are more concerned about bankruptcy.

2. *Creating an incentive to stay within a regulatory perimeter.* Banks within the regulatory perimeter are heavily constrained and so have a permanent desire to shift their activity to the less regulated shadow banking universe. Granting private banks rents for being in the regulated sector counteracts this urge.

3. *Overcoming financing frictions.* Banks might have superior investment opportunities, but other frictions limit their ability to take advantage of these opportunities without sufficient net worth. Granting a deposit franchise increases bank net worth and allows them to take advantage of the opportunities.

These are strong arguments for preserving the franchise value of banks, especially in competition with fintechs. However, they are not absolute. Even if the need for a franchise value is acknowledged, it is not clear that it should be satisfied mainly by limiting competition on payments and deposit-creation activities. Overall, those arguments show the difficulty of finding a proper equilibrium between the objectives of efficient payment and efficient credit distribution when, as in the euro area, banks play a major role in financial intermediation.

Digitalisation creates a new competitive environment where non-banks, such as BigTech firms, enter the market and lead to innovations. Other developments can foster competition among existing banks as they reduce consumers' switching costs. "Open banking" that will allow customers to transfer their data across banks is one prominent example. What will be the aggregate impact of these developments? To answer these questions, one has to have a clear understanding of the various rationales for bundling financial services and for recognising a special role for commercial banks.

Commercial banks are in the business of lending to firms and households. They are also in the business of creating deposit money. The lending activity is reflected on banks' asset side of the balance sheet, while deposit taking is on their liability side. Deposit taking is closely linked to payments.

A priori, it is not obvious why those activities should be bundled together and offered by the same institution. One could easily envision an arrangement in which banks specialise. Some specialise in lending activity, funding themselves on funding markets, while other focus on payments and deposit/money creation. The latter are often referred to as "narrow banks"; they could also be payment platforms operated by fintech companies.

Synergies as a rationale for bundling:

Explicit synergies between lending and deposit creation are a powerful argument for bundling of both activities. Kashyap et al. (2002) argue that economies of scale in liquidity management create synergies between lending and deposit creation. They observe that banks face unpredictable outflows of funds when depositors withdraw their deposits and when borrowers draw down on their credit lines. To manage possible outflows, commercial banks hold liquid assets, but this is costly because liquid assets have a low yield. If deposit demand shocks and credit line demand shocks are not perfectly positively correlated, then a bank providing both deposits and credit lines can manage liquidity more cheaply than other financial intermediaries.

Central banks have a superior technology for providing a medium of exchange because they do not need to hold liquid assets; they can simply print the money. Hence, in principle they could crowd out commercial banks from the deposit business. As pointed out by Piazzesi and Schneider (2020), unless the central bank also provides credit lines, this will make credit line provisioning more expensive because the commercial banking sector can no longer take advantage of the synergy between deposits and credit lines.

The main policy conclusion of the synergy rationale is not necessarily to rule out CBDC but to condition how CBDC should be designed. By paying a lower interest rate or capping holdings, the central bank should be able to balance the benefit of cheaper money creation with the cost of higher credit line creation and improve welfare.

3.3. The digital euro and monetary policy

From a macroeconomic perspective, a digital euro would simply be a new form of central bank money. It would have the same issuer: the central bank. It would be an almost perfect substitute to cash and present the same characteristics of safety and liquidity. It would not, by itself, increase the supply of money in the economy nor change the policy rate determined by the central bank. It would be neutral. Simply changing the form of public money should be *a priori* neutral and indifferent for monetary policy, as it would result in no discernible macroeconomic impact.

However, two nuances should be brought to that statement. First, the digital euro may trigger a shift from bank deposits to central bank money. That would affect banks' funding and, potentially, their ability to grant credit. It could therefore impact the transmission mechanism of monetary policy. This point is discussed in detail in the previous section. Second, the digital euro could become non-neutral *by design*, for instance if it were decided that it could carry an interest rate, positive or negative. Then its macroeconomic impact would be very different from cash. This will be a major choice to be made when deciding on the key features of the digital euro.

3.3.1. The technical possibility of negative interest rates

Contrary to cash, it would be technically possible to impose an interest rate on a public digital currency. Many economists consider this as a major improvement and a reason to introduce the digital euro. They see in a public digital money the possibility of increasing the efficiency of monetary policy. A general effect would be to increase the amount of money in the economy that is sensitive to the interest rate, thus rendering the transmission mechanism more efficient. A more specific advantage would be to allow the imposition of negative interest rates on the currency.

At the moment, negative interest rates can be applied only on reserves held by banks via the deposit facility rate (DFR), a measure which is still considered largely unconventional. Some economists would favour negative nominal interest rates on money held by the general public. Their reasoning comes in three parts. First, they note that advanced economies, especially the euro area, may have entered a period of very low equilibrium real interest rates. In this regime, there is a frequent need to bring policy rates at zero or below. Second, imposing negative interest for the general public is currently impossible as there is always the possibility to move to cash, which carries no interest rate. Third, as a consequence, monetary policy is constrained by the zero or effective lower bound on nominal interest rates, which prevents it from reacting appropriately to downward risks to price stability and the possibility of deflationary pressures. A CBDC with a negative interest rate would alleviate this constraint and make other unconventional monetary actions less necessary.

However, these potential benefits must be balanced against the very detrimental effects that negative interest rates would have on the acceptability of the digital euro. Moreover, citizens would still have the possibility to hold cash as an alternative, if and when negative interest rates would apply. Even if negative interest rates were applied only sporadically, they may have a dissuasive effect *ex ante* and fragilize the circulation and trust in the digital currency.

3.4. The central bank in the economy and society

3.4.1. Size of Eurosystem's balance sheet

Following the 2007-2008 financial, European sovereign debt and COVID-19 crises, the balance sheet of the Eurosystem has expanded by more than a factor of 6. Its imprint on financial markets has increased in proportion. Depending on its feature and acceptance, the digital euro could mark a new phase of expansion as well as introduce a larger role of the Eurosystem in financial intermediation. Whether those trends will materialise will partly depend on people's attitudes. But it will also be result of design and policy choices. By and large, central banks set the conditions for access to their balance sheets. The digitalisation of money will necessitate many such decisions in the period to come.

The digital euro could become either a complement or a substitute to cash. In the first case, it would add to the aggregate claims held by the general public on the central bank and increase its balance sheet. A larger part of money balances held by citizens and corporates would be in the form of central bank money.

Another driver of the expansion of Eurosystem's balance sheet would be the longer-term refinancing that it would provide to banks that lose deposits. By itself, this policy would expand the central bank balance sheet (as well as requiring the mobilisation of collateral). Supposing there is a permanent shift from deposits to the digital euro, then there would be an equally permanent increase in the Eurosystem's role as one intermediary between the source and destination of credit. It is impossible to assess precisely whether and to what extent this transformation would influence credit allocation. Bindseil (2020) has identified some consequences. Should the banks rely permanently and significantly on central bank funding, their incentives could change. They could devote less resources to monitoring credit. Large scale refinancing would then transform credit allocation towards a different model, more akin to an originate-to-distribute way of functioning.

3.4.2. Access to Eurosystem's balance sheet

Central banks' balance sheets will also be driven by how the new payment actors – BigTech and stablecoins – will be incited (or forced) to manage their reserves and liquidity. In some models (China, the model advocated by Carney, 2021), all their reserves are deposited at the central bank, which puts

it in a privileged position to regulate their activity and exercise oversight of the payment system. Conversely, the central bank may want to avoid giving those intermediaries a privileged backing. That would give the money they issue a quasi-public character, distort competition, consolidate the lock-in effect of their platforms, and, ultimately, delegate to them a form of sovereign monetary power.

3.4.3. Token and account-based money

Finally, and above all, the role and place of the central bank will be very different depending on whether the digital euro is token-based or account-based. In the first case, citizens, while holding a direct claim on the central bank, will not have a direct and personal relationship with it. On the contrary, with an account-based system, hundreds of millions of people would become depositors at the central bank. The management and client relationship could be, to some extent, delegated to private intermediaries. But the central bank may have to assume some legal, operational and financial responsibilities. Its role in AML surveillance and its function as a retail payment operator, its accountability to its depositors would have to be precisely defined. It is very likely that the central bank would be drawn into activities and territories that are very unfamiliar and fundamentally transform its role and place in the economy and society.

Box 6: Token- and account-based money

In monetary economics, the distinction between token- and account-based money has been introduced in Kahn et al. (2009) – although they used a different terminology (instead of token they mention “store of value” payment instruments). The distinction is based on the type of verification required by each system: “Verification of identity is central to accounts systems, just as counterfeit protection is central to store-of-value systems.” Account-based refers naturally to bank money, whereas token/store of value can represent both banknotes and digital money – for which privacy and anonymity can be preserved.

While very illuminating, the distinction cannot be used without precautions:

- In technological parlance, a token can be many things with no relation to a monetary unit.
- Symmetrically, some “tokens” used as application of digital money can be a representation of some account-based (bank deposit) money.

A more accurate terminology would be to refer to digital money in the form of “bearer instruments” that can be exchanged peer-to-peer. The technological infrastructure and identity/privacy characteristics are decided by the issuer and the regulatory authority according, in particular, to the following criteria: (1) whether the instrument is linked or not to a personal identity, and (2) whether it is recorded in the ledger as a separate individual unit or part of a balance held by a specific entity.

Both distinctions have immediate implications for the privacy and anonymity regime. An instrument with no link to any identity would be easily accessible through a password, fully private, but not traceable. This raises difficult issues of compliance with KYC and AML regulations. At the opposite end of the spectrum, an instrument recorded as part of a balance held by an identified individual would, from a payment perspective, look very similar to a bank deposit.

3.5. Monetary sovereignty and internalisation

3.5.1. The ability to conduct monetary policy

Monetary sovereignty can be defined as the ability to conduct an independent monetary policy. In international economics, it may involve trade-offs and choices on the exchange rate regime and capital account opening. The most fundamental component of monetary sovereignty, however, is domestic. For a central bank to conduct an independent monetary policy, it must control the unit of account that prevails in its jurisdiction. If the unit of account is defined as the central bank liability, it can then fix the overnight interest rate and, by arbitrage, influence the whole set of monetary and financial conditions.

In sum, monetary sovereignty largely identifies with the integrity of the unit of account and a uniform currency. To the extent it protects and underpins both, the digital euro could appear as an essential component of sovereignty in a digital world.

3.5.2. Strategic autonomy through payment systems

In everyday language and politics, the concepts of sovereignty and strategic autonomy are closely related. That is true, as well, for money and payments. The dimension of strategic autonomy is important in payments.

Payments depend on critical infrastructures with a clear European dimension. Many efforts are currently deployed to strengthen and improve the efficiency and speed of domestic retail payments in Europe. They include both public and private initiatives. In that context, increased competition in retail payments, coming from large digital operators ("BigTech") will bring many benefits, but also additional challenges. Large private digital networks may naturally lead to an increased fragmentation and the build-up of dominant positions. They may not spontaneously internalise the imperatives of continuity, resilience, and cybersecurity.

There is a public good aspect to the functioning of payment systems. The ability to pay safely and efficiently everywhere and at any moment in time is a basic necessity for any society and economy. No disruption or interruption is acceptable. Ultimately, the sovereign is responsible and accountable for the accomplishment of those vital functions, that have implications for civil peace and social cohesion. Everywhere, the distribution of banknotes is managed as a public service – while printing itself is often delegated to the private sector. In most countries, and certainly in the euro area, the central bank directly operates the core systems that underpin wholesale payments. It has an oversight responsibility in retail payments.

The central bank also assumes responsibility for financial stability and is the lender of last resort to financial intermediaries. The architecture and functioning of payments systems largely determine how efficiently it can perform those tasks. Most wholesale payment systems use central bank money as their settlement instrument. Digitalisation may lead to different configurations where networks do not necessarily rely on existing payment schemes and clearing and settlement arrangements (Panetta, 2020). For example, Libra was an "integrated construct that simultaneously encompasses a new settlement asset, a new payment rail and new end-user solution" (Panetta, 2020).

How payment systems will adjust to the new phase of digitalisation is therefore essential for Europe. To the extent that the presence and ubiquity of public money is judged as essential, it should inspire the design and adaptation of payment systems. In return, the digital euro may be conceived as part of broader vision on European payments and should be designed in that perspective.

3.5.3. Data: a new dimension of monetary sovereignty

On 1 March 2021, leaders of four EU countries reportedly sent a letter to the President of the European Commission, in which they wrote: "data has become a new currency which is mainly collected and stored outside Europe" (Eder, 2021). While technically not fully accurate, this formulation captures a fundamental reality: in the age of digitalisation, money and data are closely linked, and they jointly define the perimeter of sovereignty.

Payment systems are one privileged entry point. Every monetary transaction is an opportunity to collect data. Every credit is increasingly based on the exploitation of data. Whoever operates payment systems therefore has a significant impact on the treatment of data in the EU. Today, a large share of retail payments is operated by foreign-based entities. Most data is stored outside the EU, which raises significant privacy issues. To some extent, the tension can be managed as current payments systems – based on banks and credit cards operators – are not built with data exploitation as their primary principle of business and source of profit.

Those models are changing, however, with digitalisation and platform-based systems. Those rely mainly upon data collection and treatment as a source of income. From a public policy perspective, technological dependence on payments will translate into less control over data. This may also compromise the pursuit of other core policies, such as the fight against money laundering, terrorist financing and tax evasion. There will be increasing convergence between data and monetary sovereignty.

At a global level, those trends may put significant limits on the efforts to build open and cross border payment systems. Future "digital currency areas" (Brunnermeier et al., 2019) may be ultimately delineated by differences in data and privacy laws. For the EU, there is a need to consider jointly the future of data and payment regulations. Sovereignty in those two domains may be hard to dissociate. If, as stated in the leaders' letter, "now is the time for Europe to be digitally sovereign," there will be implications for how payments systems are structured. Obviously, the digital euro, if created, would only be part of the solution. It could help and catalyse many essential components of digital sovereignty, such as, for instance, the creation of an EU-wide ecosystem for digital identities.

3.5.4. Digitalisation and the international monetary system

Digitalisation has the potential to reshape the international monetary system. As cross-border payments become easier, currency competition may increase and also develop into new dimensions. It may no longer be based only on the macroeconomic and monetary performance of currencies, but also on pure digital interconnectedness and the bundle of services that platforms, networks and stablecoins will offer to users. Specialisation may occur, independent of the characteristics and specificities of each jurisdiction. For instance, some networks could intensely exploit or sell users' data, whereas others may prioritise absolute privacy. Intercountry links may increasingly depend on whether those digital payment systems will – or not – be made interoperable.

In this context, the launch of CBDCs by many countries, first of all China, has often been interpreted as the first act in a new and fierce international currency competition. Whether it will happen or not depends on the forces that drive the international adoption of money. There are, schematically, two ways through which a currency can internationalise: first, by becoming a global store of value, as a reserve instrument; second, by being used for international payments, as a medium of exchange. Historically, the two roles have progressively converged. However, different paths and strategies are conceivable for a currency to gain international status and use in the 21st century. Analysing the current dominant position of the dollar in the international monetary system, some economists (as e.g. Eichengreen 2005) emphasise its function as a reserve asset, based on the size, depth, and liquidity of

US financial markets. Others (as e.g. Gopinath et al., 2016) give more importance to its role in the denomination and settlement of international trade and transactions. The distinction becomes relevant and important in a digital environment. Becoming a reserve asset is demanding as it implies, in particular, full and unconditional capital account convertibility. However, if international status can be achieved through trade, a country that is home to large digital networks could find new ways for its currency to gain international acceptance. Digitalisation may thus serve as a powerful vehicle to internationalise some currencies as media of exchange⁷. It is also likely that the internationalisation of a currency will occur via stablecoins, which are subject to the right amount of regulatory scrutiny.

The euro, of course, has the capacity to internationalise along both dimensions: as a reserve asset and medium of exchange (as well as a funding and vehicle currency). It is beyond the scope of this study to discuss whether it should do so. According to the ECB (2020) report on the digital euro, fostering the international role of the euro is not a prime motivation for issuing it. However, should it be created, the design of a digital euro will *de facto* reveal and imbed preferences regarding its cross-border role. It would also have implications for the international role of the euro.

Privacy, degree of interconnection, and interoperability (both with other CBDCs and foreign private systems) are features that will matter. Direct connections between CBDCs could enhance the safety of international payments, including for transfers of remittances. At this stage, therefore, no option should be excluded.

If, for instance, international cooperation would develop to the point where several CBDCs become interconnected and interoperable, it would be important to participate actively in the definition and operation of cross-border standards. Also, depending on its design, the digital euro may or may not have an imprint and impact on the currencies of those countries that are economically close to the euro area, whether in Europe or other regions. Two objectives may be taken into consideration, which are not necessarily compatible in all circumstances: first, whether the euro area wants to facilitate cross-border transactions with neighbouring countries; second, whether it will encourage, or not, the "euroisation" of their economies.

⁷ See "International currency competition: the digital dimension" at Markus Academy, Bendheim Center for Finance, Princeton University. <https://bcf.princeton.edu/events/jean-pierre-landau-on-international-currency-competition-the-digital-dimension/>

4. TRADE-OFFS AND POLICY OPTIONS

4.1. Radical change or continuity?

The debate on CBDC has been described as “a battle for the soul of the financial system” (Cecchetti and Schoenholtz, 2021). Sceptics see CBDC as an attempt, by governments and central banks, to fundamentally transform the way financial intermediation works and re-establish public money in a dominant position. Indeed, the digital euro could, in theory, be conceived and designed as an instrument for radical change in current monetary and financial arrangements. However, there is no indication that this perspective is considered by the Eurosystem or any other EU institution.

4.1.1. The possibility of radical change

The central bank could theoretically decide to exploit forcefully all the possibilities offered by digitalisation and combine them with its capacity to issue a superior form of money - with no constraint on making a profit. It could then:

- (1) open individual accounts to all citizens, which is today technically feasible (a solution sometimes called “reserves for all”),
- (2) use that possibility to operate targeted drops of “helicopter” money on selected parts of the population,
- (3) issue a digital euro that would carry interest, thus reinforcing significantly the transmission mechanism and directly competing with private money as a store of value,
- (4) in the process, directly intermediate a significant part of credit as it would collect deposits and refinance banks, placing them in a situation of dependence for most of their funding.

All those possibilities have been extensively discussed – and frequently advocated – by economists and analysts. Describing that scenario immediately illustrates the numerous challenges it raises. It would change the nature of currency. It would transform the relationship between citizens and money. It would put the central bank in a totally different role and position in the economy and society.

While any option deserves to be discussed, it will be assumed, in the remaining parts of this study, that directed and radical change is not the perspective adopted by policymakers. Following their statements and declarations, we will consider a different approach to the digital euro, based on preserving the current equilibrium between public and private money in the economy.

4.1.2. The contours of continuity

Describing a scenario of radical change illustrates, by strict symmetry and contrast, the main contours of the solution of continuity:

- (1) The Eurosystem does not open individual accounts to citizens. Instead, the digital euro is issued in the form of a bearer instrument (a “token”), as close as possible to a digital cash that can be exchanged on a peer-to-peer basis,
- (2) The digital euro does not carry interest and is not considered as a tool of monetary policy,
- (3) The Eurosystem does not try to compete systematically with private deposit and payment services. Instead, it tries to create complementarities and synergies between private and public digital monies.

4.2. The delicate balance between ubiquity and monopoly

4.2.1. A difficult reconciliation

As a public money, the digital euro will have to be universally accepted and widely accessible. On the other hand, the Eurosystem may not want to evict private money issuers (the banks) or private payment providers. It may not want to gain a monopoly or dominant position in retail payments. It will thus be placed into a strange and paradoxical position. It wants the digital euro to be present everywhere but important nowhere. It wants it to be successful but not too successful (Bindseil et al., 2021). It certainly helps that the central bank aims at providing a public good and may not feel constrained by profit or cost recovery objectives. Nevertheless, performing that delicate balancing act is made fundamentally difficult by the economics of money.

Achieving ubiquity without monopoly is (relatively) easy in a physical environment, with public money in the form of cash. All central banks devote significant resources in ensuring that cash is always present and accessible in their territory, including its most remote parts. The technology of ATMs has proved, over the last five decades, an extremely powerful tool to guarantee the ubiquity of public money.

Things may be different in a more digital environment.

First, the equivalent of a “digital ATM” would be the applications that citizens install on their mobiles and that merchants accept. Those decisions are decentralised and not controlled by the authorities. Technical choices can therefore lead to the exclusion – or total domination – of public money.

Second, a digital economy is driven by network effects and externalities. Money is a network good and digital money even more so. The more people use it, the more attractive and valuable it becomes, the more it brings in new users. As a consequence, acceptance of money and its usage are neither progressive nor linear. They are subject to sudden and ample shifts. To oversimplify, faced with the introduction of a new form of money, an economy will naturally oscillate between two extremes. Either the new form of currency fails or it dominates. These are precisely the corner situations that a digital euro wants to avoid, staying instead in the middle ground. Finding the right balance will necessitate a very fine design.

4.2.2. The case for “digital legal tender”

Legal tender exists for physical cash. There is a good case for extending it to a digital euro. Legal tender performs two fundamental functions. First, it coordinates expectations on the acceptance of money. Second, from the point of view of merchants, it creates incentives to invest in terminals and infrastructures that can process public money. Legal tender would ensure ubiquity of the digital euro without necessarily requiring it to dominate existing and future payment systems.

Legal tender can also be a powerful weapon to force the interoperability between digital platforms and the uniformity of the currency. If all existing private payment systems, whatever their size, function and destination, are legally obliged to allow and accept the digital euro as an internal settlement asset, it would create a *de facto* equivalence between any specialised token that may be created and circulate on those networks⁸.

4.3. The digital euro and bank funding

As a group, banks draw part of their funding from refinancing operations conducted by the central bank. To the extent they lose deposits as a consequence of the digital euro, these refinancing

⁸ See Brunnermeier and Payne (2022) for a more detailed analysis and trade-offs that come with a digital legal tender.

operations may grow in volume and relative importance⁹. Should it lead to specific policy measures and corrections?

The answer to this question depends on whether preferential treatment of banks is welfare-enhancing for society. Possible reasons are discussed in Box 4 in Section 3.2.2. On a theoretical level, Brunnermeier and Niepelt (2019) show that it is possible to devise a set of public policies that would fully neutralise the impact of a digital euro on commercial banks. Their neutrality theorem is subject to strict conditions. However, it gives a framework of reference to consider policy options (see Box 7 next page).

⁹ These analyses refer to a “normal” situation where banks are, in aggregate, short of reserves. In the current period, with significant excess reserves, there is no aggregate funding problem for banks and the digital euro could be introduced without causing any aggregate disturbance. Paradoxically, as long as the deposit facility yields a negative interest rate, a digital euro today would help banks by reducing the amount of their excess reserves.

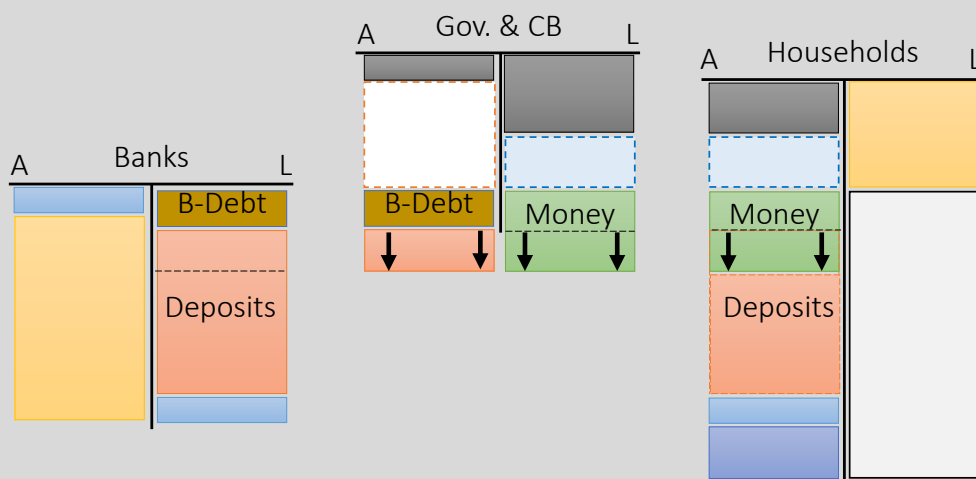
Box 7: The digital euro, financing short-falls, and bank runs

Sceptics of CBDCs warn that a major drawback associated with the introduction of a digital euro could be the resulting higher funding costs and higher likelihood of runs on private credit institutions such as banks, with obvious repercussions on the stability of the whole financial system. Specifically, they argue that the availability of an easily accessible and potentially safe asset such as the digital euro (as CBDC) might encourage savers to withdraw their bank deposits and move the funds to their digital currency wallets or accounts at the central bank whenever their risk perception – even slightly – deteriorates.

While this line of reasoning may seem appealing, it neglects countermeasures available to the central bank, should it face a run on a private bank towards its digital currency. In fact, as Brunnermeier and Niepelt (2019) show, whether the introduction of the digital euro could undermine financial stability would crucially depend on the strength of the central bank’s commitment to act as lender of last resort. In particular, if such a commitment were strong, a transfer of funds from deposit to the digital euro would translate into an automatic substitution of one type of bank funding (deposits) by another one (central bank funding). This shows, then, that a swap from deposits the digital euro would not reduce bank funding, but rather change its composition.

Figure 2 illustrates the working of such a “pass-through” mechanism: Were households to expand their digital euro (“money”) holdings and lower their deposit holdings (see the arrows on the asset side of the household sector’s balance sheet), the central bank’s liabilities would expand correspondingly (see the arrows on the liabilities side of the central bank’s balance sheet), counterbalanced by its acquisition - in exchange for digital euro holdings - of claims *vis-à-vis* the banking sector (see the arrows on the asset side of its balance sheet). That is, the central bank would automatically provide substitute funding for banks, effectively intermediating between non-banks and banks.

Figure 2: Pass-through funding of banks



Source: Brunnermeier and Niepelt (2019).

Importantly, not having a digital euro might make a currency run into a foreign or cryptocurrency more likely.

4.3.1. The refinancing approach

One such option could be to create specific refinancing modalities for compensating any deposit loss due to the digital euro. Those modalities could be transitory – to absorb the initial shock of the introduction - or, on the contrary, be made permanent – to compensate for a structural shift in money holdings. Specific features could involve the maturity and, possibly, the interest rate applicable within predefined limits. One big advantage for banks would be the automaticity.

4.3.2. Drawbacks and limits of the refinancing approach

It is not clear, however, that specific changes to the operational framework of central banks will be necessary or justified. Potential shifts in money holdings are difficult to assess *ex ante*. In most probable scenarios, they can be accommodated by available refinancing facilities. The central bank may want to keep the flexibility of its actions and adapt them to the circumstances if necessary.

If, over the longer run, refinancing needs grow significantly as a result of the digital euro, two broader policy issues may emerge. The first is technical but important: the situation may create, for some banks, a shortage of available collateral. The second is more fundamental. High and permanent refinancing needs would change the relationship between commercial banks and the central bank. It would place banks in a situation of dependence and may affect, in unpredictable ways, their incentives and credit behaviour. It would also increase the role and place of central banks in financial intermediation and their (indirect) imprint on credit markets.

4.4. Specialising the digital euro as a medium of exchange

A digital euro would be well-placed to serve both as medium of exchange and store of value. However, if it were to become a form of investment, the risk of large shifts away from bank deposits would become significant. To avoid such displacement effects, the specialisation of the digital euro as a pure medium of exchange may be considered.

4.4.1. The case for specialisation

Specialisation would present many benefits. In economic terms, the amounts necessary for transaction balances are limited whereas those for store of value are potentially infinite. Limiting the digital euro to its medium of exchange function is quantitatively less disruptive to other financial actors and intermediaries.

As a medium of exchange, the digital euro would still potentially compete with banks in payment services. However, this would only add one actor to an already very competitive environment. Banks are, and will increasingly be, submitted to intense competition in digital payments from other service providers, especially BigTech. The digital euro would not compete with banks on the bulk of their deposit-taking and financial intermediation activity. It would not attack their franchise, which depends on their ability to combine their deposit-taking, money creation and lending activities.

Specialisation is also advantageous from a privacy perspective. In the current framework for cash applicable in most countries, privacy is recognised for transactions (up to a certain amount). It is implicitly denied for holdings of large quantities – the store of value function. Currently, when important amounts of cash are exchanged, they have to be declared and explained. The specialisation of digital euro as a pure anonymous medium of exchange would explicitly reproduce that distinction.

Specialisation would also solve the problem of non-residents and allow to control internationalisation of the digital euro. Transaction balances would be accessible to anyone anonymously up to certain

amount. Hoarding of digital euros by non-residents would be impossible (just as for residents). Of course, they would still have access to the euro in its other forms (bank deposits and cash).

A digital euro limited to its medium of exchange function may have to be bundled with other functionalities – including programmable uses – developed by private intermediaries to foster common end-user European solutions. It could represent a building block for a European solution for point-of-sale and online payments. The idea fits well with the declared ambition to make the digital euro a catalyst and a support for payment innovation in Europe as well as a tool for greater strategic autonomy. The modalities and conditions of such bundling would have to be carefully designed to ensure both the universality and the neutrality of public money in the digital payment system.

Limiting the function of a digital euro would not prevent the public sector from supplying safe stores of value to financial intermediaries and the general public. Safe assets perform an essential role in the economy as collateral, pillars of financial intermediation and definition of risk-free interest rates. Such safe assets, however, are already provided by government bonds and central bank money held by banks in the form of reserves.

4.4.2. The limits of specialisation

While the operational case for specialising the digital euro is straightforward, the economics are more uncertain and ambiguous. Money, as a perfectly safe and liquid asset, jointly performs three functions. Separating them by design, however justified, introduces a discontinuity that may have negative side effects.

In some circumstances, the distinction between a medium of exchange and a store of value is not clear-cut.¹⁰ People usually hold money in advance for the case that a purchase opportunity arises. They may search and when they accidentally find a suitable product they can immediately make the purchase. The longer the search is expected to last, the lower is the velocity of money, and the higher is the demand for money. Strictly speaking, during the search phase, money stores wealth with the intention to use it as a medium of exchange. Both roles complement each other, which blurs the line between the medium of exchange and the store of value roles of money.

The key and subtle policy question is the following: how far can the medium of exchange and store of value be artificially dissociated from each other without compromising the unit of account and the anchoring function of public money? In concrete terms, would the existence of small and limited transaction balances in digital euro suffice to incite economic agents to denominate all their operations in euro?

Historically, the coincidence between the medium of exchange and the unit of account seems well-established and robust – although not absolute. There are very few historical examples – and almost none in recent times – when people did not count, contract and trade with the same monetary unit.

In modern economies, however, financial activities are very developed. When agents enter into debt, derivatives and other contingent contracts for the future, the choice of the unit of account denomination is essential. In some literature (Doepke and Schneider, 2017; Brunnermeier and Sannikov, 2016), considerations of risk sharing and asset liability management determine the choice, by intermediaries, of their preferred unit of account. Network externalities develop and create convergence on a single unit (as natural monopoly), which may not be the official currency (see e.g. Dowd and Greenaway, 1993). This theoretical framework may become increasingly relevant in a digital

¹⁰ The challenge of separating the medium of exchange and store of value role of money is part of a long-lasting debate as e.g. also the Cambridge cash-balance approach stipulated by Pigou (1917), Marshall (1923), Robertson (1922), and Keynes (1923) highlights.

environment of DeFi and closed networks, where the possibility – and the incentive – to use specific units of accounts will be larger and stronger. The key, here, is that the process is disconnected from any transaction in real goods. Limiting the digital euro to a medium of transaction role might prevent it to penetrate those activities and let them develop outside the reach of the central bank.

Finally, specialising the digital euro as a medium of exchange will necessarily involve setting some limits to its holdings. One of the main benefits of public money – its elasticity of supply – could be diminished or compromised. If the limits are strict and rigid, it would introduce frictions in the convertibility of private into public money.

4.4.3. Capping and tiering

To specialise the digital euro, the Eurosystem would have to set an acceptable level of transaction balances. Limits would have to be defined. Below some level, use and holding of the digital euro would be free and anonymity guaranteed. Above, identification would be the norm. In addition, there would be disincentives, or pure prohibition, to holding digital euros above the limit. Limits can be set either through quantitative (ceiling) or price (tiering) mechanisms. Both solutions are differently attractive.

A cap/ceiling on individual holdings of digital euro could be instituted. It has many advantages. It is fully transparent, clear, and easily understood. Its quantitative impact can be directly assessed *ex ante*. It gives certainty and permissibility to banks and authorities alike. From a user perspective, a “waterfall” mechanism can be instituted, whereby any balances in digital euro in excess of the ceiling would be automatically converted in deposit money and transferred to the user's bank account.

Obviously, a cap does not guarantee a fully elastic supply of the digital euro. It may have complex effects on the perceived safety of bank deposits in times of crisis (as it would limit their convertibility). It also carries implicit choices on privacy as digital euro holdings of each individual (or corporates) above the threshold would need to be clearly identified.

Tiering would be based on a different principle. There would be no hard limit, but holdings above certain threshold would be dissuaded. For instance, transaction balances below a defined threshold would carry no cost nor benefit. Above and beyond that threshold, a fee would be applied. Conceptually, it would correspond to the safety premium that holders would be asked to pay for storing value in the central bank's balance sheet. Operationally, it would create a disincentive to excess holdings. The separation between the CBDC's roles as a medium of exchange and store of value would not be as brutal and discontinuous as with a hard limit.

From a theoretical perspective, it would be advantageous for the fee to take the form of a time-varying (negative) interest rate. Its level could be flexibly adjusted in times of stress to price in the increased demand for safety and discourage runs from deposits. Any flight to safety could be accommodated, at least in part, by changes in prices rather than by significant quantitative shift in the holdings of different forms of money. Financial instability created by large asset reallocation might be avoided (absent any signalling effects).

Tiering, however, would bring its own challenges. First, the mere prospects of negative interest rates could reduce the acceptability of CBDC and compromise its primary objective of universal and ubiquitous presence in the economy. Second, the central bank would be perceived as deciding upon two interest rates: one is the policy rate applied to its deposit/refinancing facilities, the other would be the (negative) interest rates on excess holdings of CBDC. Third, changing the penalty rate might have an adverse signalling effect and worsen a panic.

From a policy perspective, a double-interest rate scheme is rational: one instrument is devoted to monetary policy; the other to financial stability. However, it is likely that a double interest rate structure

would create confusion and blur the communication on monetary policy. In periods of uncertainty, it may create doubts and reduce trust in the digital euro itself.

To avoid those reactions and problems; it may be preferable to organise the tiering on a different principle. A progressive fee structure could be established, with several thresholds of holdings and increasing levels of penalty. The structure would be fixed, intangible and independent of the economic, monetary and financial situation. It would be a constitutive element of the digital euro. Revisions could only be considered at predetermined periodicity.

4.5. Technical choices on infrastructures: preliminary considerations

Technical choices are beyond the scope of this study. They are being considered and explored all over the world by central banks engaged in CBDCs, see e.g. Duffie et al. (2021). Most of them, except for China, are still in preliminary or pilot phases. The Eurosystem has started consultations with private participants.

However, details of design will unavoidably impact fundamental policy choices. This section presents only some very preliminary considerations. It will be presumed that the digital euro will be issued to the general public as a “cash-like” bearer instrument. That instrument should be usable both online and offline (with proper limitations) i.e. from one mobile phone to another. Even people without a mobile or smart phone should be able to use it. This is a societal and policy choice. A “cash-like” bearer instrument leaves open several possible technical options. For example, the Eurosystem can choose the degree of centralisation or delegation in the ledger structure and operational responsibilities.

Two key objectives seem to dominate the current thinking:

First, the central bank should be the only entity that is allowed to issue digital euro (CBDC) units and remove them from circulation. This is clearly a matter of fundamental principle. The central bank has the monopoly of issuance and full control of its own liabilities. This applies not just to the overall aggregate amount but also to any single unit of digital euro. Technical arrangement should prevent the issuance of the digital euro by any other actor than the central banks. For instance, banks should not be allowed to offer deposit accounts in digital euro, even if fully backed by reserves held at the central bank.

Second, the central bank should want to keep the option to identify the owners of digital euros if and when necessary. This is considered important for compliance with existing AML and KYC regulations. It is equally necessary to implement, if so decided, a specific regime applicable to non-residents.

Prima facie, those two objectives would best achieved by the so-called “direct” model of digital euro. In this model, the central bank keeps its own ledger, executes retail payments, defines the interconnections with private systems and implements the privacy regime. Interactions with private actors can be managed through application programming interfaces (APIs). They can take place at different levels: either wholesale settlements or retail devices such as digital wallets.

An alternative is the “indirect” and tiered system where some functions are entrusted to supervised intermediaries, both banks and non-banks. These intermediaries could be responsible for keeping ledgers and operating payment services, including providing access devices and channels and effecting transactions. In addition to defining standards and supervising the intermediaries, the central bank would keep a record of different aggregate amounts of the digital euro.

There are many advantages attached to an indirect operational architecture:

(1) It may be more conducive to preserving competition and efficiency in payments.

(2) It gives more flexibility in deciding and implementing privacy options (which may vary according to country-specific requirements and preferences).

(3) It may facilitate acceptance of the digital euro if, for instance, it can share the retail applications and wallets with existing private digital currencies.

(4) Finally, it may make it easier to ensure full interoperability between the digital euro and private forms of money. The whole purpose is to make digital euro as fully substitutable to private money as possible. Technical interoperability will be an important determinant. There are many dimensions and requirements to interoperability, including through regulation. It can be achieved at different levels. It is clear, however, that full and easy exchangeability at the user end will help and mimic closely the current perceptions associated with physical cash.

5. CONCLUSION AND PERSPECTIVES

The digital euro project is driven by two forces. One is digitalisation and the profound disruptions that it brings to money and payments. The other is the push towards a more unified and autonomous payment system in Europe. Those two forces largely work in opposite directions. Digitalisation naturally tends to segment and organise the economic space around technological borders that have no direct link with the EU/euro area jurisdiction.

The digital euro may be essential to overcome this contradiction. It would allow euro area citizens to reap the benefits of digital money while, simultaneously, protecting the uniformity of the currency. It would be the anchor and pillar of single European payment space.

But it may not be sufficient. Payments sit at the intersection of many initiatives and EU policies. They have a close link with money (the topic of this study). They also involve data and privacy. The technical dimension – interoperability – is central. The future European payments landscape will be defined by the interaction between private and regulatory initiatives. All are in a state of flux. On the private side, the most notable evolution is the European Payments Initiative (EPI), a collaborative project developed by major European banks. As for public policies, both the European Commission and the ECB have adopted retail payment strategies. Both institutions cooperate to complete the Single European Payments Area (SEPA) project. Most of the directives that regulate payments are currently under review (payment services Directive [PSD2] and Directive on settlement finality in payment and securities settlement systems) – or being debated (Markets in Crypto-Assets Regulation [MiCA]). There is now an opportunity to define and shape the architecture of European payments for the digital era.

For the digital euro to produce all its expected benefits, it must develop in coherence with its regulatory environment. Major pieces of regulation currently considered or debated will directly impact money and payments. They will define the place and role of private digital money, how it interacts with the digital euro and whether complementarities and synergies will appear in shaping the future payments landscape.

As described in this study, digitalisation will create a more diverse and complex architecture, with possible additional layers of financial intermediation. It will also produce a broader spectrum of diverse financial and monetary assets with different degrees of safety and liquidity. Should stablecoins, e-money, cryptocurrencies and other types of digital tokens be equally treated as money or should there be a differentiation? Should regulation incite them to converge with banks through capital requirements? Should they be treated separately, as payment providers?

When answering those questions, regulators are primarily concerned with preserving financial stability and market integrity. Most regulatory regimes are based on a classification of actors and activities along several dimensions: the technology (regulation of DLTs is emerging), the type of activity and the risks attached to it, the business model of the intermediary. All those elements contribute to identifying the threats to financial stability.

From a monetary angle, however, there is a different – equally central – question: which of those assets will – or should – qualify as money? What matters are the properties of the asset itself – whether it has the features of money, whether it will contribute to the uniformity of the currency. What gives an asset its "moneyness" is the constancy of its nominal value across time and space. That value cannot be sensitive (allowed to change) with new information or the state of the economy (Dang et al., 2015).

Taking a monetary perspective necessitates a slightly different approach to regulation, centred on the asset itself not on its issuer. A digital financial asset – for instance a stablecoin – may be fully backed, its issuer may be perfectly sound and, yet, it may not be proper for use as money.

To a large extent, public policy itself will determine what is money: “moneyness” depends on legal status, backing, convertibility and the connection to the central bank (or absence of it). Hence, policymakers do not ask whether assets issued by a specific institution is money. They determine whether they want it to be money and define the regulatory regime accordingly. Technological innovation makes it necessary to have a precise vision of what money should be and base public policy on that perspective.

The study considers the preservation of a uniform currency as an overarching priority and the main justification for the creation of a digital euro. Within that framework, however, several options are possible. At the extreme, two opposite visions can be defined: soft and strong uniformity.

A system inspired by a “soft” vision of uniformity would accept and encourage the competition between different forms of private money (as long as they are denominated in euros) through different regulatory regimes. This is more or less the current situation. For instance, both e-money (as defined by the Directive) and bank deposits are legal claims on the issuer. But, stablecoins (as defined in the draft MiCA Regulation) are not. However, e-money, contrary to bank deposits, does not benefit from deposit insurance. Under a soft vision of uniformity those differences are accepted and result in a gradation between different forms of money from the perspective of safety and liquidity. This approach is most favourable to competition in payments and may be beneficial to innovation. It may also be adapted to digital currencies (stablecoins) principally exchanged between financial intermediaries, who are more equipped to trade assets with differentiated characteristics. However, it will be challenging to ensure that specific regulatory regimes will not result in different kinds of money, issued by different entities, with different degrees of safety and liquidity. Soft uniformity will rely on the ability of oversight and supervisory authorities to monitor future evolutions and adjust legal and policy regimes if necessary.

By contrast, strong uniformity is based on two principles: a clear and absolute separation between what is money and what is not; and a fully unified policy and regulatory regime between the different forms of private money. Since the private money of reference are bank deposits, strong uniformity would submit all issuers of private money (including stablecoins) to a form of banking regulation and supervision – with, *inter alia*, some capital requirements. This approach is currently considered for stablecoins by some countries, e.g. the United States¹¹. It brings great clarity and robustness to the policy framework. Conversely, it may limit competition, innovation, and the ability of payment systems to develop flexibly and independently. Furthermore, the reference and equivalence to banking raises two difficult questions: what kind of public guarantee would new forms of private money possibly benefit? What would be their relationship to the central bank and possible convertibility into central bank money?

Whatever option is chosen, monetary arrangements in the euro area should continue to be based on the complementarity and cooperation between public and private issuers of money. That complementarity has served the public well over the last decades. It brings a positive combination of private initiative, competition, and innovation, with the stability and uniformity provided by central bank money. The ultimate justification of the digital euro is to maintain that equilibrium in a rapidly changing environment. Its success will be determined by the ability of different actors to preserve the complementarities and synergies between their respective actions.

¹¹ Report of the President’s Working Group on Financial Markets, the Federal Deposit Insurance Corporation and the Office of the Comptroller of the Currency (2021).

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The study identifies the fundamental rationale for a possible issuance of a digital euro: to preserve the role of public money in a digital economy. It outlines the policy options, trade-offs as well as design issues that its creation would raise.

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