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“Central bank digital currency: handle with care”

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- Mistrust in fiat currencies, increased preference for electronic means of payment and demand for cheaper and faster cross-border payment solutions have contributed to the emergence of a large number of private digital currencies, the so-called cryptocurrencies. Because of their features, cryptocurrencies – including bitcoin – are ill-suited to fulfilling the function of money.
- However, rapid progress on stablecoins – a category of cryptocurrencies featuring greater stability of value – seems to have played an important role in the decision of many central banks around the world to start exploring central bank digital currencies (CBDC). In most cases, the possible launch of a digital currency is still some years away.
- Issuing a CBDC available to households and firms poses big challenges. For a central bank of a developed country, it is not obvious that CBDC represents the most suitable tool to increase the efficiency of the payment system.
- This is especially the case in the euro area, where the unique institutional framework makes it more complicated for the ECB to manage the issue of bank disintermediation. A hard cap on the maximum CBDC holdings and the introduction of a European deposit insurance scheme (EDIS) would help reduce the risk of bank runs.

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Executive Summary

Mistrust in fiat currencies, increased preference for electronic means of payment, demand for cheaper and faster cross-border payment solutions and progress on distributed ledger technology have created fertile ground for the emergence of a large number of private digital currencies, the so-called cryptocurrencies. Cryptocurrencies are exchanged peer-to-peer and anonymously (to some extent), and transactions are cleared in a decentralized way. They are privately issued, so they are not backed by legal-tender status, nor do they carry any claim of convertibility into cash.

We look more closely at bitcoin as the reference point in the cryptocurrency universe. Bitcoin has attracted huge media attention and thousands of products and services have been built around it to facilitate storage and exchange. However, bitcoin's intrinsic features make it prone to speculation, exposed to large price swings and subject to regulatory risk. Therefore, bitcoin is ill-suited to perform the functions of money, namely a means of exchange, a unit of account and a store of value.

In general, the main innovation and advantage of cryptocurrencies reside in the payment technology rather than in the digital currencies themselves. The features of the bitcoin system are being fine-tuned and improved by the proliferation of alternative coins and new protocols, set to overcome some of its limitations. In particular, stablecoins have been developed to respond to the need for a digital currency with a more stable value better suited to preserving purchasing power. Digital units designed as part of the Libra/DIEM project – supported by tech giants with access to billions of potential coin users around the world – belong to this category. Still, widespread use of stablecoins would pose significant challenges for governments and regulators at both the micro (e.g. user data protection and anti-money laundering) and macro (e.g. global financial stability and monetary policy effectiveness) levels.

The threat to national monetary sovereignty posed by stablecoins and the need to prepare for an increasingly cashless society all seem to have played an important role in the decision of central banks to explore the possibility of issuing central bank digital currency (CBDC).

In this paper, we analyze CBDC in its retail version (i.e. accessible to the general public). We argue that issuance of CBDC poses fundamental questions and meaningful technical challenges. Central banks generally claim that the main goal of CBDC is to improve the efficiency of their payment systems. However, we do not find it obvious that a central bank of an advanced country with a developed financial sector and a high level of financial inclusion should enter the market with its own digital offer. Even if we accept that a central public authority should be directly involved, we are not convinced that CBDC, with its complexity, represents the best tool to achieve a more efficient payment system.

From a technical perspective, a CBDC would pose important challenges for the banking sector and have meaningful implications for financial intermediation, implementation and transmission of monetary policy, as well as financial stability. The effects of CBDC mainly depend on **1.** how the asset side of the central bank's balance sheet would change to match the increase in liabilities originating from the issuance of a digital currency, and **2.** the technical features of CBDC. We argue that issuing CBDC would lead to severe side effects, which the central bank would need to mitigate by boosting its liquidity provision and/or by purchasing bank bonds outright. It is of outmost importance that central banks design their digital currencies in such a way as to make them appealing as a means of payment, but not as a store of value.

Finally, we discuss the challenges to the ECB's CBDC project stemming from the unique institutional framework of the euro area and investigate the possible impact of retail CBDC on the eurozone banking sector. We think that a hard cap on the maximum retail CBDC holdings and the introduction of a European deposit insurance scheme (EDIS) would help limit deposit volatility and reduce the risk of bank runs.

I. Cryptocurrencies

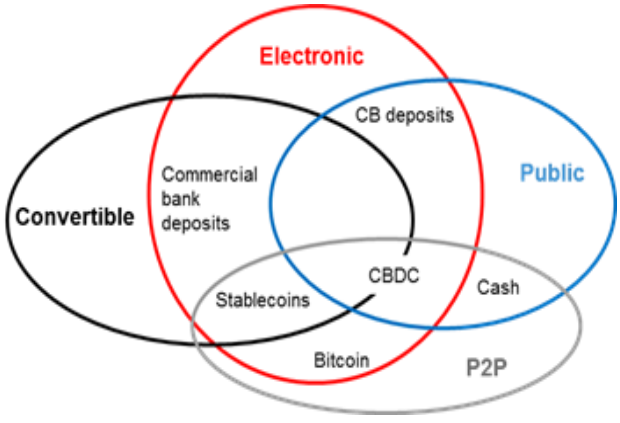
Since 1971, when the dollar's convertibility into gold was suspended, monetary systems of most developed countries have been based on fiat currencies. A fiat currency comes in the form of coins and banknotes as well as central bank reserves and represents a claim on the issuer, a central authority (e.g. a government via the central bank), which also makes it legal tender. Given that they are not backed by a physical commodity and cannot be redeemed, fiat currencies do not have intrinsic value; their nominal value is guaranteed by law and depends on the central bank, which seeks to preserve this value over time through its monetary policy.

Mistrust in fiat currencies along with increased user preference for electronic means of payment over cash and demand for cheaper and faster cross-border payment solutions have created fertile ground for the emergence of alternative means of payment. Distributed ledger technology has fueled this trend, allowing for the development of new decentralized payment systems and new digital units of exchange, such as cryptocurrencies.

Cryptocurrencies include a large number of digital units of payment enabled by the use of cryptography, which share a few key features. In order to discuss some of their characteristics, we introduce a taxonomy for money, referring to BIS (2017) and Bofinger (2018), which distinguish between electronic and physical, publicly and privately issued, peer-to-peer and intermediated, and convertible and non-convertible money (chart 1). Like electronic money, cryptocurrencies are digital in nature. There is no physical coin or bill. They can be transferred online and stored in digital wallets. Like cash, they are exchanged peer-to-peer and in anonymity (to some extent) and transactions can be completed without intermediaries or a central clearing authority. Moreover, like cash, they have no intrinsic value. However, as they are privately issued, they are not legal tender and carry no legal claim of convertibility into cash. The popularity of cryptocurrencies has grown steadily over the past few years and their total market capitalization is over USD 1.5tn (Coinmarketcap.com). The symbol of this universe, bitcoin, accounts for over 40% of the total.

CHART 1: WHAT ARE THE CHARACTERISTICS OF DIGITAL CURRENCIES?

Money classification



Source: UniCredit Research

I.1 Bitcoin

Bitcoin is a payment system that allows peer-to-peer payments denominated in bitcoin (currency) building on distributed ledger technology. Over the past few years, it has attracted sizable press coverage and its popularity has gone hand in hand with its rise in price (in USD terms, chart 2).

BOX 1: BITCOIN PAYMENT SYSTEM AND CURRENCY

The bitcoin system started to operate in 2009, following the publication of a white paper by one or a group of authors under the pseudonym Satoshi Nakamoto. The paper discussed a new form of peer-to-peer electronic cash system with bitcoin (currency) as its unit of account. Decentralization is a key feature of the system. It is built on distributed bookkeeping, allowing digital exchange of bitcoins without intermediaries by using consensus-based validation and cryptographic signatures. There are three main components in this system: users, miners and the blockchain.

Users have one or several wallets and a combination of a public (bitcoin address) and a private (e.g. password) key. They can create a new wallet for every transaction from which they can transfer bitcoins by authenticating the transaction with their private key. There is no other evidence of bitcoin ownership in the network besides having the relevant private key. Transaction details, including the payee, the paid amount and the transaction fee the user is willing to pay, are broadcast to the network and processed by miners.

Miners select unprocessed transactions and perform all necessary checks, including whether the payer has enough funds, by parsing the entire blockchain, which is the ledger of all validated transactions. Bitcoin is a public and permission-less database, so no authorization is needed to become a miner. However, adding a new block of processed transactions to the chain is computationally intensive and it requires finding the solution to a complex cryptographic puzzle. The successful proof-of-work allows the miner to add the new block and collect a reward. Miners compete to add new blocks, attracted by the block reward, which consists of newly minted coins (they also collect transaction fees). This process drives issuance of new bitcoins (money supply) according to a pre-specified supply path at a decreasing pace until reaching a cap (21 million units). Past that point, miners' remuneration will cease to come from newly minted coins and will have to come from transaction fees.

The chain of all processed blocks of transactions is broadcast across the network and becomes the reference ledger once it emerges as the consensus version. The bitcoin protocol clarifies how the consensus version is selected and how the integrity of the ledger is preserved. In this respect, some argue that consensus about the rules and the state of the system, as well as the fact that bitcoins are valuable, are all needed to ensure the system's success (Halaburda et al., 2021).

In contrast to the fiat currencies of most advanced economies, bitcoin is ill-suited to perform the functions of money. The key reasons are the lack of legal underpinning, its high price volatility, its capped money supply, high regulatory risk and the risk of much higher transaction costs in the future.

Price volatility

Bitcoin's price has proved extremely volatile (chart 3). This results from its fully fiduciary nature as well as its lack of intrinsic value, any backing from public authorities or status as legal tender, and its hard-coded money growth path. Price volatility is entrenched in bitcoin's nature of a pure asset, not matched by a claim on any entity. This is a feature that bitcoin shares with commodities and one of the reasons why it has also been defined as digital gold, even though there is zero non-monetary demand for it.

Like cash, bitcoin has no intrinsic value, but unlike cash, its value is not protected against full implosion by having legal-tender status (Bofinger, 2018). Hence, bitcoin is fully fiduciary and its value is based on the extent to which it is accepted as a medium of exchange as well as on the reliability of its underlying digital infrastructure. In other words, by separating money from the government, bitcoin substitutes trust in the public authority with trust in the bitcoin system under the assumption that governments would accept its existence and potential role – an assumption that has recently been questioned, for example, by Chinese authorities' actions.

Its fully fiduciary nature exposes demand to large fluctuations based on sentiment, making it a speculative asset. Bolt et al. (2020) highlights that while cryptocurrencies might become less volatile if they become more established and the share of consumer/merchant transactions increases (and the share of speculators decreases), their volatility is likely to remain well above that of traditional currencies because of their inherent features. The hard-coded supply cap of bitcoin also contributes to fueling speculation.

CHART 2: A SHARP DROP AFTER RALLYING FOR MONTHS…

Bitcoin price

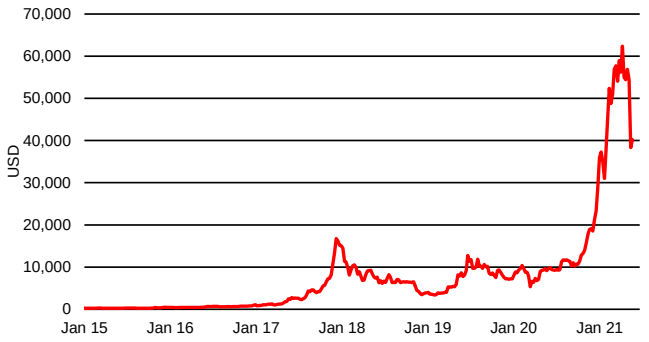
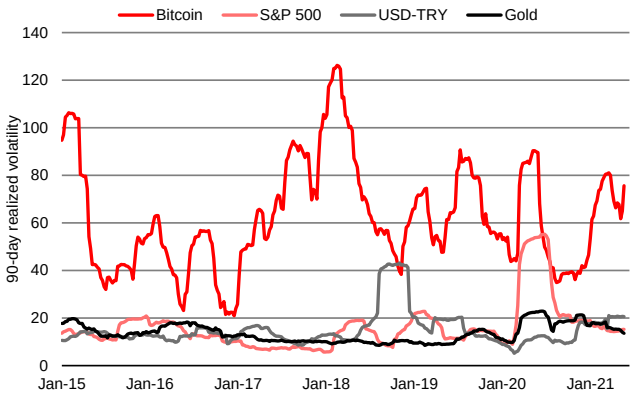


CHART 3: …AND HUGE VOLATILITY

90-day realized volatility (%)



Source: Bloomberg, UniCredit Research

Capped money supply and its implications

Decentralization is a key feature of the bitcoin system and is embedded in the way money is created. Coins are minted privately based on a shared protocol, with incentives to maintain and support the system. The quantity of coins that can be minted (money supply) grows at a decreasing rate and its total is capped (chart 5). Neither total bitcoin supply nor its pace of growth can be adjusted. This has made bitcoin appealing to investors that fear debasement of fiat currencies by central banks at times of ultra-expansionary monetary policy, or to critics of the role of financial intermediation in money creation.

However, a fixed bitcoin supply exacerbates price volatility caused by changes in demand, and is absolutely no guarantee that bitcoin's value will continue to trend higher, given that the aggregate supply of cryptocurrencies is not capped. More attractive cryptocurrencies might emerge in the future and competition might drive demand out of bitcoin, affecting its value. In a hypothetical world where bitcoin is the dominant currency, a totally exogenous money supply would cause welfare-destroying volatility in prices and activity while making bitcoin inherently deflationary (Ali et al., 2014). Note also that miners might have an interest in hoarding bitcoins to sustain the value of their revenue streams and by limiting further money supply, they would reinforce these risks.

High regulatory risks

A key feature of cryptocurrencies is anonymity. The extent to which transactions are anonymous varies across different cryptocurrencies, but generally speaking a high level of privacy is embedded in their systems. The bitcoin system is actually pseudonymous rather than anonymous. Transactions are stored on the public ledger and could be accessed if the access keys of the user are known, but its set-up increases challenges for authorities when controlling fund flows. While anonymity is generally accepted and often practical for small sums (e.g. use of cash for everyday transactions), it would become problematic for potentially large sums as it might offer a payment channel to illicit activities.

Research on this topic points to illegal activity being a substantial part of bitcoin usage, at least in its early stages. Foley et al. (2019) found that a quarter of bitcoin users were involved in illegal activity and they accounted for nearly half of total transactions. However, they also point to the decreasing relevance of such activity. Tasca et al. (2018) suggest that some of the concerns about the use of bitcoin for illicit transactions might have been overstated and the share of such transactions will likely diminish as the bitcoin economy matures. That said, because of its features, bitcoin allows transfer of funds outside official channels in a more effective way than cash. This might help circumvent limitations on financial flows imposed by authorities. Some countries are taking steps to address bitcoin's ability to operate outside controlled channels. This increases the regulatory risk for bitcoin and cryptocurrencies in general, as shown by Chinese authorities' recent crackdown on mining and trading, and by the US Treasury's call for stricter rules on transfers of over USD 10,000.

CHART 4: BITCOIN MARKET CAPITALIZATION NEAR USD 0.8TN

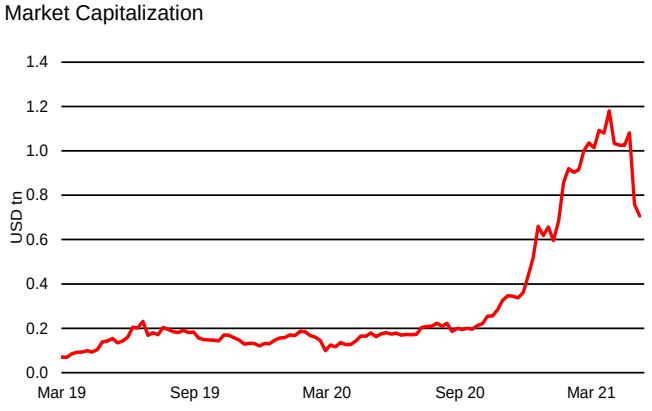
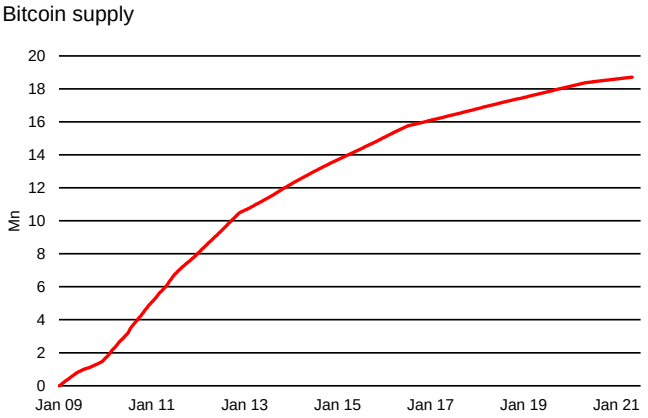


CHART 5: DECELERATING SUPPLY



Source: Bloomberg, UniCredit Research

Transaction costs and environmental footprint

Transaction fees for bitcoin exchanges can vary depending on how congested the system is or the size of the transaction, and this might also affect the time needed for its successful completion. Bitcoin is generally considered less effective (cost/speed) at handling payments than traditional electronic systems, especially when transaction demand is high, and more effective systems are being developed. That said, transaction costs are generally kept low by the subsidy miners receive from the creation of new bitcoins. By design, over time the computing power needed to mine will increase, while the stream of revenues will dry up as the supply cap is reached. This might drive transaction costs higher, reducing the appeal of bitcoin as a form of payment. Auer (2019) highlights that the proof-of-work system might not be able to generate sufficient fees to guarantee payment security when the value of the block reward is low. Another consequence of the increasing computational power needed for the system to work is high energy consumption. According to the Cambridge Bitcoin Electricity Consumption index, its current annual consumption is comparable to the amount of energy consumed by a middle-sized country.

Bottom line

Bitcoin is the reference point for an increasing number of cryptocurrencies, private digital assets built on cryptography, which are becoming more popular as they benefit from connections to a growing number of digital services in everyday life. However, due to its intrinsic features, bitcoin appears prone to speculation and ill-suited to perform the functions normally attached to money. That said, it might still be regarded as a valuable instrument in specific circumstances, for example in countries where highly unstable domestic currencies and limited access to hard currency make it difficult to preserve purchasing power, or where traditional channels limit the scope for money transfers.

In general, the main innovation and advantage of cryptocurrencies reside in the payment technology rather than the digital currency itself. Bitcoin features have been fine-tuned and improved upon by the large proliferation of alternative coins and new protocols designed to overcome some of the limitations discussed above. In particular, stablecoins have been developed to respond to the need for a digital currency with a more stable value, better suited to preserving purchasing power, and creating a better connection between fiat currencies and the cryptocurrency universe.

I.2 Stablecoins

Stablecoins include a large number of digital currencies that leverage blockchain technology but are substantially different in their structure compared to other cryptocurrencies. They are privately issued digital currencies, allowing transactions to be settled in a decentralized way, which seek to overcome the limitations caused by the large price swings in other cryptocurrencies by maintaining a collateralized peg to some underlying asset. This is often a fiat currency such as the US dollar, but collateral might include a pool of currencies, commodities or cryptocurrencies. By design, stablecoins represent a claim on the issuer, the private entity responsible for their convertibility into the underlying collateral. The DIEM project (formerly Libra), albeit still in the making, is probably the most discussed of the stablecoin initiatives. However, currently the largest stablecoin by market capitalization (nearly USD 95bn) and trading volume is Tether, while alternatives such as USD-coin are gaining ground (chart 7).

CHART 6: THE EFFECT OF THE COLLATERALIZED PEG

Tether price in USD

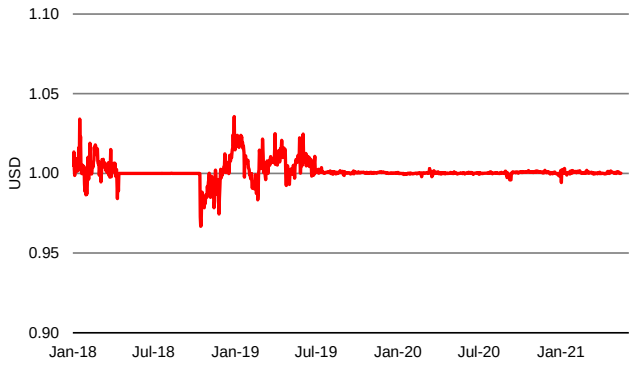
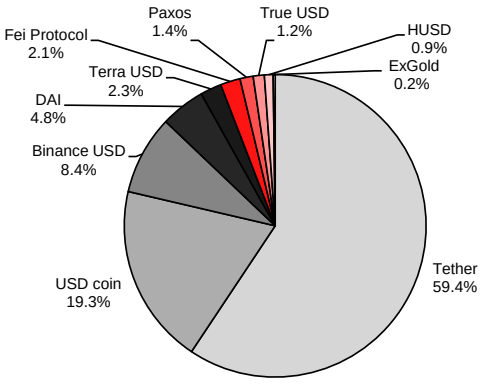


CHART 7: TOP TEN STABLECOINS BY MARKET CAP

Share of total market cap



Source: coincodex.com, UniCredit Research

At least in theory, their characteristics make stablecoins a better-suited option than cryptocurrencies to fulfil money's role as means of payment and store of value. Their use might spread quickly, particularly if promoted by large tech companies (e.g. social media) that can leverage a vast number of users. However, they pose some serious challenges and risks when it comes to user protection, competition policy and financial stability.

Peg and collateral management

Because of their structure, particular attention is attached to the nature and security of the collateral that backs stablecoins. The largest stablecoins generally have collateralized one-to-one pegs to the US dollar, holdings of which match the value of the outstanding currency.

There are also versions pegged to different kinds of collateral. Given their collateralization, stablecoins are similar to electronic money, which is backed by funds held on a bank deposit, but the institutional set up guaranteeing the value of redemption is very different. Funds placed in bank deposits sit on the balance sheet of regulated intermediaries and are ultimately (at least in part) backed by deposit insurance. In contrast, the ability to dispose of stablecoins rests on the trust in their private issuer and/or the legal framework guaranteeing access to the collateral upon redemption. User protection is also a key focus for regulators, which exposes stablecoins to significant regulatory challenges.

Purpose and reach

The need for faster and cheaper cross-border payments has been widely acknowledged. The G7 Working Group on Stablecoins (2019) suggested that new technologies might address these shortcomings and foster financial inclusion in a world in which nearly 2bn people are unbanked or underbanked. Stablecoins aim to bridge this gap, offering low-cost and rapid global payment solutions (generally) without the need of intermediaries and by using units of account that overcome some of the limitations seen in other cryptocurrencies, particularly when it comes to their stability in value. They could also be thought of as a vehicle to connect traditional currencies (used as collateral to obtain a stablecoin) to the cryptocurrency universe, given the ease of exchange between stablecoins and other cryptocurrencies. Moreover, the support offered by tech giants might facilitate access to such digital currencies for billions of users worldwide. This is the case for Libra/DIEM.

BOX 2: DIEM (FORMERLY LIBRA)

DIEM is an independent association, supported by a number of tech companies, responsible for the development of the DIEM project, which aims to enable “universal access to financial services”, by building on blockchain technology. DIEM has not been launched yet, but has already received a lot of attention from media and regulators. The published white papers illustrate the project and its intended structure.

According to the information available to date, DIEM is set to create a payment system supporting both single and multi-currency coins. The latter will be a basket of single-asset coins, defined in terms of fixed nominal weights. In line with the typical stablecoin structure, single-currency coins will be backed in full by collateral denominated in the relevant currency and characterized by low credit and interest rate risk. More specifically, at least 80% of the collateral pool would have to be invested in government securities with a maturity up to three months, highly rated and with high secondary market liquidity. The remaining 20% would be placed in cash or money-market funds.

The collateral will be held in a reserve, which will also hold a capital buffer. The funds will be placed in a number of custodian banks. Moreover, the reserve will commit to full transparency and auditability. The positive (negative) interest earned from the collateral will be reflected in lower (higher) transaction costs or other fees, but coin holders will not earn a return from the reserve. The above set-up might change in the future, but when it comes to collateral management and access to collateral upon redemption, a key issue of any design is trust in the issuer and/or the existence of an appropriate legal framework to safeguard users over time.

The DIEM system will not interface directly with users, but instead with a number of designated dealers, who will make a market on the coins and will deal with the DIEM association on one side and with users on the other side. Based on current plans, dealers will be required to market coins within “tight spreads” and be able to accommodate “high volumes of trading”. Dealers will mainly interact with virtual asset service providers, in turn offering financial services to end users. Such providers will have to comply with regulations on anti-money laundering and anti-terrorist financing. Specific procedures are to be designed to run operations in an emergency, including a run on the system.

From Diem To CBDC

The initiative has attracted significant attention from regulators, and DIEM mentions throughout its website its intention to cooperate with relevant authorities and abide by relevant rules. In fact, some fine-tuning of the initial projects has already been done in response to concerns raised by regulators. DIEM went a step further, raising hopes that central banks would develop their own digital currencies (CBDC) so that these could be integrated in the DIEM network, for example substituting the relevant single-currency stablecoin with the CBDC. This would reduce credit and custody risk for the reserve, and turn DIEM into a de facto global system of payments for CBDC.

Key problems remain unresolved

However, a number of serious problems remain to be solved. At a micro level, they relate to ensuring smooth functioning of the payment system, mitigating cyber and operational risks, guaranteeing protection of users and data, as well as adhering to regulation on anti-money laundering and terrorism financing. A global payment system also requires the definition of a relevant jurisdiction in case of disputes. At a macro level, unless properly supervised, stablecoins raise risks of unfair competition in financial markets that might affect global financial stability and limit the effectiveness of monetary policy. Finding a solution might be extremely difficult, if not impossible, given the determination of authorities to maintain their monopoly on issuing money and regulating exchanges.

II. Central bank digital currency (CBDC)

A central bank digital currency (CBDC) is a digital fiat liability of the central bank, denominated in an existing unit of account, which is accessible by certain categories of economic agents and that can serve both as a medium of exchange and as a store of value.

If a CBDC is intended to be used by households (and, presumably, firms), it is usually referred to as a "general purpose" or "retail" CBDC. In contrast, a "wholesale" version of CBDC is only intended to be accessed by financial institutions and is similar to today's central bank reserve and settlement accounts. Given that the bulk of the current debate is centered on retail CBDC, throughout this note we refer to this version[1].

A third kind of central bank money

Traditionally, access to digital central bank money has been limited to commercial banks and a few other specific institutions that hold central bank reserves. In contrast, physical central bank money, i.e. cash, is accessible by a much wider public. Retail CBDC would be a third kind of central bank money, a digital currency issued by a central bank that can be made available to the general public. Such CBDC would not aim to replace cash, but to be a complementary means of payment. Importantly, however, central banks have not yet elaborated persuasively on the specific problems CBDC would solve, nor have they clarified the – supposedly big – opportunities that the issuance of their own digital currencies would bring.

Why issue CBDC?

There appear to be three main reasons why central banks are exploring the possibility of introducing CBDC:

1. The use of cash has declined rapidly in some jurisdictions (chart 8) and the trend might broaden globally, especially after the pandemic. In an extreme situation, this would mean the general public losing access to central bank money. In such an environment, trust in the currency would then totally depend on trust in financial intermediaries, which issue commercial money by "creating" deposits;
2. Big tech firms have been increasingly involved in the provision of financial services, leveraging on their extensive network of users on social media, access to consumer data and mobile technology (chart 9). Their projects to launch stablecoins with a vast pool of potential users might have been a wake-up call for central banks, which want to preserve their monetary sovereignty, support the global role of their respective currencies and contain systemic risk;
3. Central banks aim to provide a universally accessible, safe, fast and efficient payment instrument, also for cross-border transactions. Progress has been slow in this regard and competition from stablecoins could potentially rise rapidly.

In January, the BIS published its third survey on CBDC among central banks worldwide. The survey shows a shift from mainly analytical work towards technical experimentation, with more than 60% of central banks globally engaged in practical experimental work, and about 15% moving forward to development and pilot arrangements. The pandemic has accelerated this trend, although this does not mean that implementation of CBDC is going to start soon[2].

[1] We consider the account-based version of CBDC, with the general public's accounts held either directly by the central bank or through financial intermediaries. In this case, payments are made from account to account and both the payer and receiver must have an account denominated in the digital currency. In the token-based version, the CBDC is linked to a physical medium characterizing ownership (for instance, a mobile phone or a payment card) and in payment transactions the receiver verifies the authenticity of the token, just like with physical banknotes. However, the payment has to happen electronically from medium to medium and not by transferring the medium itself.

2 There is one (small) exception; in October 2020, the Bahamas was the first country to launch a "live" general purpose CBDC for its residents (the sand dollar). In China, the PBOC is expanding its digital-yuan tests on a larger scale in several regions.

According to the BIS survey, motivations related to efficiency, safety and robustness of the payment system (reason 3 above) have been, and remain, the key factors leading central banks to explore CBDC. This holds true not only in developing countries where payment systems are less efficient, but also in advanced economies.

Fundamental questions and technical challenges

The issuance of CBDC poses fundamental questions and brings big technical challenges. Fundamentally, and barring a clear market failure, it is not obvious that a central bank of an advanced country with a developed financial sector and a high level of financial inclusion should enter the market with its own digital offer. Moreover, at least so far, central banks have not really elaborated in depth on the inefficiencies they want to tackle through the issuance of CBDC (Bofinger and Haas, 2021). Therefore, we suspect that factors 1 and 2 above – namely the need to prepare for a scenario of an increasingly cashless society and the rising threat to monetary sovereignty and the international role of domestic currencies posed by big tech firms and their stablecoins – might have played more of a role in central banks deciding to get involved in digital currency than suggested at face value by the BIS survey.

CHART 8: USE OF CASH IS DECREASING

US: share of payment instrument usage

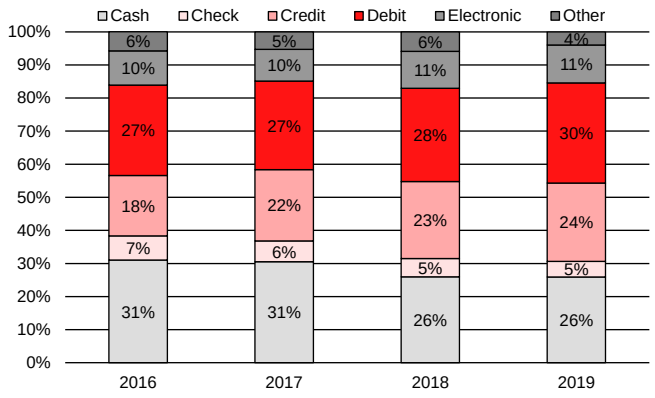
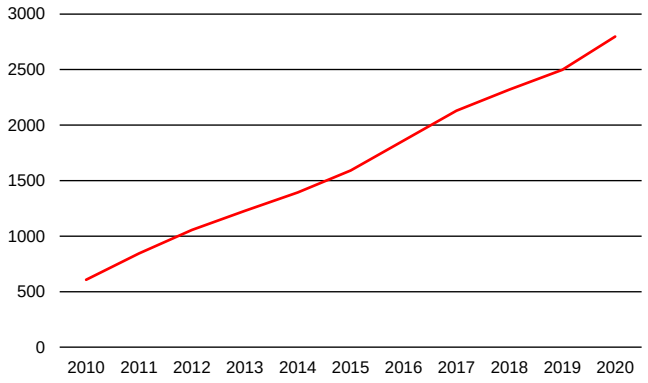


CHART 9: RISING INFLUENCE OF TECH GIANTS

Number of monthly active Facebook users worldwide (millions)



Source: Federal Reserve Bank of San Francisco, Statista, UniCredit Research

II.1 Challenges for the banking sector

From a technical perspective, a CBDC would pose big challenges. In this paper, we will not deal with the legal and technological issues a central bank faces when launching CBDC. Instead, we will focus on the impact on the banking sector and the implications for financial intermediation, implementation and transmission of monetary policy, and financial stability.

Disintermediation would pose a severe challenge to banks

As the issuance of CBDC encourages the general public to substitute commercial bank money with central bank money (disintermediation), banks would face three major issues. First, they would de facto be competing against the central bank to attract deposits. Obviously, the general public would regard CBDC as safe asset by definition. A reduced deposit base would negatively affect the availability of bank credit to the real economy and/or its cost. Second, CBDC could curtail banks' payment business, and the customer information that comes with it. Third, a decline in the deposit base and a replacement with other liabilities might lower banks' ability to fulfil regulatory liquidity requirements, given that most regulations treat household deposits as a stable liability.

While we are confident that regulation can be adjusted relatively easily to take new developments into account, the first two factors are likely to have more far-reaching implications (see Box 3 for more details).

In general, a CBDC accessible by the general public, but (most probably) subject to holding limits, will likely – and certainly in times of crisis – lead to a sort of internal exchange rate between bank deposits and CBDC. This would be highly distortive and bad for the economy. Ultimately, the effects of CBDC mainly depend on **1.** how the central bank's balance sheet will change as a result of the issuance of the digital currency, and **2.** the technical features of CBDC. In this regard, the key decision by the central bank will be on how to design CBDC in order to make it appealing as a means of payment, while limiting its store-of-value function. We assess these two factors in turn.

II.2 Changes in central bank assets

The issuance of CBDC will affect the balance sheets of central banks and of the banking sector – unless substitution into CBDC only involves banknotes and not commercial bank deposits, which we regard as highly unlikely.

The role of the asset side of a central bank's balance sheet

From the perspective of a central bank, issuing CBDC would lead to an increase in liabilities that would need to be matched by an increase in assets, for instance through outright purchases of securities or by increasing liquidity provision for the banking sector. How the central bank decides to manage the asset side of its balance sheet will be crucial to understanding the implications of CBDC for banks.

Banks' possible reactions to disintermediation

Commercial banks, which use deposits to fund their assets, might react in different ways to a loss of deposit funding. They could try to replace lost deposits with other, more costly, sources of funding, such as deposits with a longer maturity or wholesale funding. Alternatively, they could decide to reduce their assets, for example by cutting back on loan provision. If the increase in central bank assets does not produce mitigating effects for the banking sector, the reduction in commercial bank deposits would lead to less availability of bank credit to the real economy, and/or increased funding costs and higher bank lending rates. This would have negative consequences for the transmission mechanism of monetary policy and banks' profitability.

The extent and the speed of disintermediation are crucial. In calm times, substitution away from bank deposits into CBDC might be relatively contained and the implications of disintermediation would be bearable for banks and the real economy if there is large excess liquidity. However, during crises that reduce confidence in the banking sector, large outflows of bank deposits into CBDC might occur, with potentially serious consequences for financial stability.

The central bank should mitigate the impact of disintermediation

If the central bank wants to contain the impact of disintermediation on the banking sector, it needs to stand ready to implement mitigating action via its balance sheet. The provision of additional liquidity to compensate for the reduced deposit base and/or outright purchases of bank bonds are the most obvious tools to achieve this. However, a systematically higher volume of refinancing operations would not come without consequences. It would probably affect the availability and price of collateral, thus making the system more vulnerable to episodes of volatility in market rates. This increased need for collateral would probably require the development of a well-functioning market for the securitization of bank loans with the aim of creating assets that have ratings adequate to make them eligible collateral. As for the central bank, it would have to accept a larger and riskier balance sheet, given the likely need to broaden the pool of assets it accepts as collateral.

It is important to note that substitution into CBDC might not be limited to cash and bank deposits, but could potentially affect a large number of financial assets. For instance, given the intrinsic safety and liquidity of CBDC accounts, investors might even want to use CBDC to substitute some of their holdings of safe assets, such as highly rated government or supranational bonds. Implications could be material not only for money market rates but also for the entire term structure of interest rates and, in turn, affect the valuation of financial assets in general. Therefore, indirectly, via discount rates, the issuance of CBDC might have spillover effects on a broad range of asset classes.

II.3 Design of CBDC: remuneration structure and limits to holdings

The design of a CBDC has significant implications for financial intermediation and the implementation and transmission of monetary policy, as well as financial stability. This is true not only domestically but also internationally, because widespread availability and accessibility of CBDCs would risk amplifying international capital flights to safe-haven CBDCs and exchange rate fluctuations during crises. This argues in favor of international cooperation on the design and use of CBDCs for cross-border payments.

In order to minimize the unintended consequences of CBDC, its technical features should make it an appealing means of payment, but an unattractive store of value. The structure of remuneration and limits to CBDC holdings are the main tools through which a central bank could try to reach this goal.

Implications of an unremunerated CBDC…

If unremunerated (i.e. non-interest bearing), a CBDC would be the digital equivalent of banknotes, but without storage costs. Although such form of CBDC would not directly transmit impulses originating from changes in the central bank's policy rates, its implications for monetary policy might still be substantial, as it could strengthen the lower bound of interest rates. The reason is that, with no limit to CBDC holdings, the general public could potentially deposit all of its liquid assets into accounts at the central bank without incurring storage costs. This would cause the effective lower bound on interest rates to rise to zero.

…and those of a remunerated version

If CBDC were remunerated, the rate of remuneration would presumably be linked to the central bank's policy rates and be a key determinant of the attractiveness of CBDC relative to other forms of money. For example, the interest rate offered by CBDC would set a floor for the return on bank deposits, given that deposits held at the central bank are safer than deposits held at commercial banks. In turn, this would influence the extent of possible substitution effects and of the resulting disintermediation. Moreover, the interest rate on CBDC could also set a floor for the short-end of risk-free government bonds[3]. The impact on the shape of the yield curve might then affect the transmission mechanism of monetary policy.

Discouraging the use of CBDC as store of value

In the likely case a central bank wants to discourage the use of CBDC as store of value (chart 10), it could decide to apply a system of limits to holdings and/or tiered remuneration. A binding, quantitative, limit would simply set the total amount of CBDC for each type of user, individuals and firms; beyond such a limit, payments could automatically be redirected to a commercial bank account. Another method would be to introduce "soft" limits, along with tiered remuneration, for instance, deciding that CBDC balances above a certain threshold (tier two) would yield a lower interest rate than that applied by the central bank to CBDC holdings below that threshold (tier one). This would allow the central bank to assign the payment function to the tier-one CBDC, while discouraging the store-of-value function of the tier two.

[3] However, in practice, demand for short-duration, highly rated government paper by financial institutions is more often driven by regulatory requirements than yields.

In our view, it would be important for a central bank to commit never to charge negative rates on tier-one CBDC – thus making it equivalent to cash – and to explicitly communicate that tier two is not meant to be an attractive store of value. This would help the central bank address criticism of financial repression and expropriation of money holders.

As a final consideration, we note that the structure of remuneration and soft limits to holdings of CBDC might not be enough for the central bank to gain full control of the impact of CBDC on the banking system. This happens because the attractiveness of CBDC as a means of payment also depends on any services that the central bank might offer to the holders of CBDC accounts, either directly or through third parties, which could be banks or non-banks.

It is unlikely that a central bank will be willing to offer a range of services comparable to those provided by commercial banks. However, if the gap is not too large, some households may no longer consider it necessary to have a bank deposit account. This would accelerate the pace of disintermediation unless hard limits to CBDC holdings are set at a reasonably low level.

II.4 The transmission of monetary policy

Implications of CBDC for the transmission of monetary policy are mixed. On the one hand, the disintermediation aspect risks impairing the transmission by throwing sand in the wheels of the banking sector. On the other hand, the central bank would see its monetary policy impulse strengthened by the fact that changes in policy rates would be immediately and directly transmitted to CBDC holdings that bear interest, and whose remuneration is linked to the central bank's policy rates. This might also help reduce the effective lower bound for policy rates. In the euro area, the transmission of ECB monetary policy is being hampered by the remuneration of household bank deposits being stuck at around zero (chart 11).

CHART 10: EURO NOTES ARE APPEALING STORE OF VALUE

Mid-point of estimated range (2019)

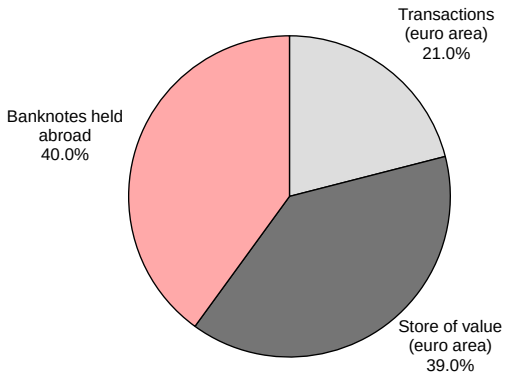
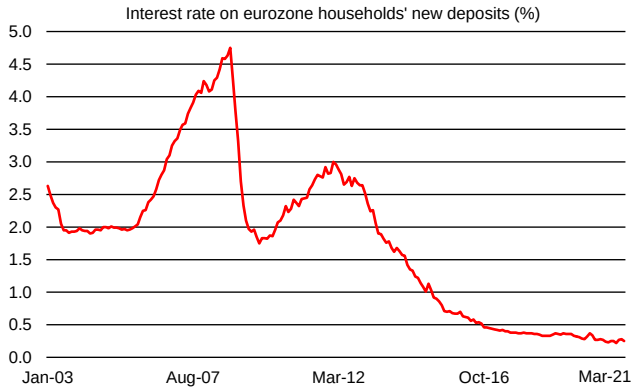


CHART 11: STICKY DEPOSIT RATES SLOW THE TRANSMISSION

Interest rate on eurozone households' new deposits (%)



Source: ECB, UniCredit Research

CBDC and helicopter money

CBDC would have positive effects on transmission if extreme economic conditions were to lead the central bank to launch textbook helicopter money. In fact, economic agents having direct access to central bank liabilities would make it very easy for the central bank to directly credit accounts of individuals and firms. However, this only considers the technical aspects of the implementation of helicopter money. In reality, and especially after the pandemic, a more desirable form of helicopter money might be one that involves government decisions on the most appropriate distribution of resources coming from the central bank.

Therefore, and leaving aside issues regarding the independence of central banks, we suspect that any future helicopter-money-like policies would have to be channeled to the real economy based on the judgement of politically elected bodies. For example, instead of a generalized transfer of funds to all households and firms, a central bank might decide to buy irredeemable debt securities carrying little or no coupon, de facto creating fiscal firepower for free. If so, the general public's direct access to central bank money might not turn out to be a decisive factor.

Mixed implications for the transmission of monetary policy

Overall, the net benefit in terms of transmission would result from the trade-off between any impairment faced by the banking sector due to disintermediation, and quick and direct transmission of the monetary policy impulses to interest-bearing CBDC holdings. The higher the public holdings of CBDC, the stronger the latter effect, but also the higher the likelihood of large-scale disintermediation and, therefore, the risk of impairment of the banking channel.

II.5 CBDC in the eurozone: amplified challenges

The pros and cons of providing the general public with direct access to central bank money should be weighed carefully, given the potentially disruptive implications that such decisions would entail. In particular, CBDC should be launched only if the central bank can be confident that the issue of disintermediation, both structural and in times of crisis, can be effectively managed. We believe that this is the case for all central banks, but especially for the ECB, which has to deal with the unique institutional features – and weaknesses – of the euro area.

The ECB is due to decide whether to launch its digital currency this summer, but a possible implementation would take years. According to ECB President Christine Lagarde, if the Governing Council gives the green light to the project, the digital euro could be issued starting around the middle of this decade.

The eurozone's unique architecture is likely to complicate the issuance of CBDC

Critical factors in the eurozone compared to other economies are the lack of a common deposit insurance scheme or (permanent) fiscal stabilization tool, the continued inconsistency of national rules for bank resolution, and the opaque procedures that govern emergency liquidity assistance (ELA) by national central banks. In this context, the risk of bank disintermediation at times of financial stress is especially present in the weakest jurisdictions, where a doom loop between banks and sovereigns, and the related perceived increase in convertibility risk, might amplify the substitution effect triggered by CBDC in normal times.

Like most central banks looking at the opportunity to issue a digital currency, the ECB is considering different options that would discourage the use of the digital euro as a form of investment and store of value. A solution envisaging a tiered remuneration has been floated, with CBDC holdings below a given threshold never subject to negative rates (i.e. never treated less favorably than cash), and those above it subject to penalizing remuneration. The ECB has provided a yardstick for such a threshold (presumably for households) at EUR 3,000 – more than the estimated amount of cash held by most eurozone citizens, and above the average monthly wage in most euro area countries.

The ECB seems to regard a tiered framework as less distortive than hard limits to discourage large holdings. However, the ECB also acknowledges that this solution might pose implementation challenges in times of crisis, when the central bank might have to adjust the remuneration of the second tier, possibly linking it to that of safe assets such as AAA-rated European government and supranational bonds. The risk is that investors might read this as a signal that the central bank is expecting financial turmoil, possibly leading to self-fulfilling instability (Panetta, 2021).

A careful assessment of pros and cons of CBDC is of outmost importance

In general, the fact that no major central bank has introduced a CBDC yet makes it even more difficult to assess the likely shift from deposits into CBDC given the eurozone's unique architecture. This calls for a careful assessment of the trade-off between first-mover advantage (via a potentially positive impact on the international role of the currency) and patience, which would allow lessons to be learned from the experience of other central banks.

Predictably, the ECB does not seem willing to interact directly with potential users of its digital euro. Front-end services for the ECB's digital currency would be provided by financial intermediaries, with banks playing a central, but not exclusive, role. Therefore, competition from non-bank intermediaries and fintechs on payment activity related to CBDC accounts would add to the challenges faced by the banking sector.

BOX 3: IMPACT OF A RETAIL CBDC ON EUROZONE BANKS

Impact on banks' deposit base

Every inhabitant of the eurozone will have the option to access CBDC up to a certain threshold without costs followed by either a hard cap or negative price incentive. Once a CBDC becomes available, banks might see a deposit outflow as retail clients shift part of their deposits into CBDC. Multiplying the EUR 3,000 limit per inhabitant floated by the ECB by the number of inhabitants in the eurozone aged 18 years or older (281mn), the maximum aggregated deposit outflow could be around EUR 850bn. The total household deposits of banks in the eurozone are EUR 8.5tn (March 2021) so the theoretical retail deposit outflows could be 10%. This could put pressure on banks' liquidity indicators and funding. Also firms might have a CBDC account, but, as far as we know, the ECB has not yet provided details on how limits to their holdings might be defined. Aggregate deposits by non-financial corporations are EUR 3.2tn (March 2021). Deposit outflows of firms could be meaningful as firms' deposits are increasingly priced at negative rates by banks and CBDC could be an attractive alternative. Although it is unlikely to see a full CBDC take-up in a short time frame, banks facing deposit outflows might have to increase their own deposit remuneration, increase central bank funding and/or raise additional wholesale funding. A changed perception on retail deposit stability could require banks to hold more liquidity buffers. All this could be negative for the net interest income of banks. A side effect could be increased demand for safe assets by banks (used as ECB collateral) that could lower yields of safe assets. However, in the current environment with negative interest rates and large aggregate excess liquidity of banks of above EUR 4tn, a moderate deposit outflow could be positive for banks.

Impact on regulatory liquidity ratios and credit ratings

Retail deposits are also seen as most stable form of bank refinancing. The introduction of a retail CBDC will lead to implications for banks' liquidity ratios like the liquidity coverage ratio (LCR) and net stable funding ratio (NSFR). For example, in the LCR retail deposits are divided into stable and less-stable portions with estimated run-off rates and assumptions could be challenged by a CBDC introduction. Rating agencies might also adjust their bank liquidity risk assessments if they believe that retail deposits might become less stable and there are no adequate countermeasures by banks.

CBDC increases bank-run risks

There are also serious implications in case of banking crisis. A CBDC has less implications in case of an idiosyncratic bank risk event. In such a case, depositors would probably withdraw their money from a weak bank to another bank or do cash withdrawals rather than transfer deposits into CBDC holdings in order to avoid unappealing remuneration on excessive CBDC holdings (if there is no hard cap). However, in case of a system-wide banking crisis (like the great financial crisis in 2008-09 or even the uncertainty in the early weeks of the Covid-19 pandemic) we see an increased risk to financial stability. In an event with a sudden and sharp deterioration of trust in the general financial system, deposits could massively flow into CBDC irrespective of the unappealing remuneration of CBDC holdings above a given threshold. This could put more liquidity pressure on banks, which could lead to undesired procyclical reduction in credit to the real economy in a crisis.

Impact on revenues from payment services

European banks make a significant share of their revenues from payments (around 8% according to Moody's). CBDC will stimulate the supply of new payment services and functionalities including alternative payment solutions (such as digital or mobile wallets) and increase payment competition, which will likely put pressure on banks' revenues. If customers transact more using CBDC, banks could lose related fee and commission income. Also, if banks play a smaller role in deposit-taking and routing of payments, they might lose important client information used to assess credit risks for lending.

Policy implications

The ECB should be ready to accommodate a CBDC introduction with additional liquidity support for banks. A hard cap on retail CBDC holdings instead of a price incentive mechanism could limit retail deposit outflows in crisis times. The introduction of a European deposit insurance scheme (EDIS), which is for governments to decide, would support trust in bank deposits and limit risks of deposit outflows in crisis times.

More implications of a wholesale CBDC

We have focused on the implication of retail CBDC. There are additional implications from a wholesale CBDC. For instance, a CBDC could allow to introduce smart contracts and payments directly on a blockchain. Another example are blockchain based securities issuances that might put pressure on DCM fee pools of banks and requires banks to ramp-up their digital capabilities. The impact will be asymmetric on banks depending on the share of their DCM revenues to total revenues and there might be shifts in DCM market shares pending on digital capabilities of banks.

Despite the risks, there might also be opportunities for banks from CBDC (partly including wholesale CBDC)

- CBDC would reduce unprofitable handling of paper money;
- CBDC might accelerate digitalization and process automization, leading to reduced costs;
- CBDC might lead to large-scale adjustments where the better understanding of distributed ledger technology by banks could lead to new business opportunities beyond traditional banking services;
- A CBDC leads to product innovation. Examples are corporate lending with a pay-per-use scheme where smart contracts with automated payments allows corporates to optimize their liquidity management. Other areas are micropayments, enhanced risk management capabilities by automizing covenant breaches or collateral enforcements.

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Further details regarding our regulatory status are available on request.

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