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DIGITAL EURO AS NEXT EVOLUTION OF THE EUROPEAN CURRENCY

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Abstract

Digitalisation has spread to every corner of our lives and transformed how we pay. In this new era, a digital euro would guarantee that citizens in the euro area can maintain costless access to a simple, universally accepted, safe and trusted means of payment. A digital euro would not replace cash, but rather complement it. The Eurosystem will continue to ensure the access to cash across the euro area. A digital euro would give an additional choice about how to pay and make it easier to do so, contributing to accessibility and inclusion. It would support the digitalisation of the European economy and actively encourage innovation in retail payments.

Keywords: *digital euro; digital payment; accessibility and inclusion; innovation retail payments.*

JEL Classification: E42, E44, E51, E52, F15

Europe has a long history of developing and refining the infrastructure that underpins the European economy and enables an interconnected union. The introduction of the euro as the common currency of the Eurosystem in 1999 was accompanied by the establishment of a Real Time Gross Settlement System for Europe. **TARGET**, as it was called, was developed as an efficient, safe, and

Annals of Spiru Haret University.
Economic Series
Since 2000
ISSN:2393-1795 ISSN-L:2068-6900
Issue 2/2022

reliable mechanism for the settlement of euro payments that would support the ECB's monetary policy through the integration of money, and financial markets.

In May 2008, TARGET was succeeded by **TARGET2**. The new system enabled even faster and more secure payments in addition to other advancements by replacing the decentralised structure and inconsistent technological frameworks of the first iteration in favour of a Single Shared Platform.

The TARGET Instant Payment Settlement, or **TIPS**, was introduced in 2018 as an extension to TARGET2. TIPS was a direct response to address the growing consumer demand for instant payments without reintroducing the complexity and fragmentation of national solutions. Among other upgrades, this new iteration offered even faster payments, enhanced resilience, and the ability for settlements in other currencies.

Defining CBDCs and the digital euro

The common denominator of each new advancement is the promise of further speed and efficiency in payments, costs savings, pan-European coverage, and additional features to address the modern needs of consumers and the Central Bank. A European Central Bank Digital Currency, or digital euro, would be the next step in this evolution. By potentially tapping into new technologies and possibilities developed and nurtured in the open blockchain space, as well as innovations honed by the wider private sector, a CBDC can be a definitive step towards ensuring that the Eurosystem remains current in the rapidly changing global landscape. A lot of questions remain open as to its characteristics and specificities of its issuance. However, before we explore the available design space, we must first establish a more detailed definition of CBDCs and the digital euro.

A Central Bank Digital Currency, as the name suggests, is a form of digital money that is issued by a central bank. For a value medium to be considered a CBDC it must fulfil both requirements simultaneously[1]. By this definition, CBDCs are not an entirely novel concept. Commercial banks in Europe, the US, and most of the developed world are required to hold a minimum amount of cash, as well as deposits with the central bank in the form of reserves. These reserve accounts fulfil the definition of a CBDC presented above, as they are digital representations of value, recorded as a liability of the central bank and an asset for the commercial bank.

[1] Coeuré et al., 2020

Annals of Spiru Haret University.
Economic Series
Since 2000
ISSN:2393-1795 ISSN-L:2068-6900
Issue 2/2022

The novelty of CBDCs and the digital euro relies on two primary factors, namely the extent to which this digital liability of the central bank is made available to the private sector and the types of technologies and systems to facilitate its implementation and additional innovations. The technological design space and options are explored in-depth later in this paper. In terms of CBDC availability, there are two models:

• **Wholesale CBDCs** pertain to the expansion of the reserve model described above to include other legal entities besides commercial banks, whether those are financial institutions or otherwise. In such a model, a CBDC would be reserved for commercial banks and other institutions appointed by the central bank to facilitate payments, remittances, and even the settlement of other financial instruments.

• **Retail CBDCs** are a form of legal tender denominated in the national currency, to fulfil the necessary functions of money, serving as a medium of exchange, store of value, and unit of account, all while constituting a liability of the central bank and asset of the private sector, meaning individuals, households and businesses.

Payment efficiency and security

Cash remains the preferred medium for exchanges today, with a 2019 ECB study reporting that it was used for 73% of Point-of-sale (POS) transactions and amounted to 48% of the total value of POS payments (down from 78% and 53% respectively from 2017). Its tangible nature, speed, and lack of fees make it convenient for local payments, and the instant transfer of value is favoured by consumers and retailers alike.

However, international and non-cash payments have grown significantly, following the exponential rise of ecommerce. From 2018 to 2019, the aggregate number of electronic payments in the euro area increased by 8% (EC, 2020) to a total of approximately €100 billion with a total value of more than €160 trillion. At the same time, reports from firms such as EY (2020) have outlined the changing sentiment towards digital payments. In a relevant survey (figure 1), top financial leaders from around the world highlighted that, by 2030, mobile payments will dominate the market, followed by biometric and digital asset-enabled payments. Payment system companies already report large increases in the transaction volumes of most online retailers. Indicatively, ACI Worldwide's relevant research (2020), showcases a 74% increase in transaction volumes for select sectors, while (Adyen, 2021) reports an increase of 30% to 50%.

Annals of Spiru Haret University.
Economic Series
Since 2000
ISSN:2393-1795 ISSN-L:2068-6900
Issue 2/2022

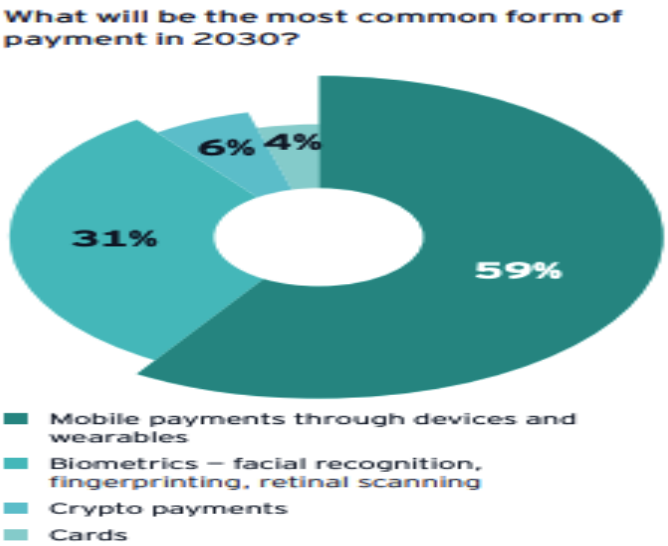

Figure 1. The future of payments.
Source: EUBOF

With the continuous shift from cash to electronic transactions the operational robustness of payments as a whole relies increasingly on credit and debit card networks, e-money providers, and point-of-sale schemes.

Depending on its characteristics and infrastructure, a CBDC can support the resilience and efficiency of the payments system by expanding services previously reserved for the commercial banking system to the wider private sector[2]. With a new or improved technological infrastructure (RTGS/DLT) a CBDC can improve resilience. In addition, a CBDC tied to real-life identities could also increase payment security and prevent money laundering and terrorist financing. The level of pseudonymity/anonymity can even be adjusted according to the specifications of the central bank, enabling even a digital alternative to cash, in terms of anonymity.

To the extent that a CBDC can act as medium for pseudonymous/anonymous payments, it could address the consequences of the declining use of cash, while at the same time promoting financial inclusion. In a scenario where cash is gradually

[2] Riksbank, 2021

Annals of Spiru Haret University.
Economic Series
Since 2000
ISSN:2393-1795 ISSN-L:2068-6900

phased out, it is reasonable to assume that commercial banks and other for-profit institutions might find it fruitless to expand their services to financially excluded groups, such as the unbanked. A substitute of cash is critical to ensure that the most vulnerable parts of our societies are not deprived of access to our economies. Regardless of whether the use of cash declines further, a CBDC could extend financial services to the 1.7 billion unbanked of the world[3] (26% in Europe). To achieve this, some minimum infrastructure would be required, notably Internet, computers and/or smartphones.

Financial Sovereignty

Central banks face two distinct types of risks that have the potential to directly threaten their financial sovereignty. Those relate to monetary policy inefficiencies, and the rising competition from alternatives developed in the private sector.

Since the Great Recession of 2008, central banks have had to resort to rather unconventional methods, such as negative interest rates and quantitative easing. A CBDC can add new weapons to the arsenal of a central bank to facilitate monetary policy and address future crises.

Central banks may also face increased competition from the open blockchain space and the private sector when it comes to the monopoly of money creation. The proliferation of cryptocurrencies, such as Bitcoin and stablecoins, is one such source of possible competition. The emergence of privately-issued digital assets, such as Facebook's Diem (formerly known as Libra) is another. Even competing CBDC deployments by other central banks, may push a central bank to rethink its own position regarding the CBDC phenomenon.

Traditional players in CBDC

United States of America: The Federal Reserve Bank of Boston announced its collaboration with MIT to research and explore digital currency and build a hypothetical CBDC (Federal Reserve Bank of Boston, 2020; MIT, 2020). After the Federal Reserve's April 2021 police meeting Chairman Jerome Powell cautioned it is "far more important to get it (CBDC) right than it is to do it fast or feel that we need to rush to reach conclusions because other countries are moving ahead."[4] The United States Securities and Exchange Commission recently suggested the

[3] Asli Demirgüç-Kunt et al., 2017
[4] Wall Street Journal, 2021

Annals of Spiru Haret University.
Economic Series
Since 2000
ISSN:2393-1795 ISSN-L:2068-6900

existence of dollar-based private sector stablecoins was in some sense a counter to China's explicit alliance building.

European Union: In its October 2020 *Report on a digital euro*, the European Central Bank stated its position on CBDCs, which includes the following key phrasing: "While the Eurosystem would always retain control over the issuance of a digital euro, supervised private intermediaries would be best placed to provide ancillary, user-facing services and to build new business models on its core back-end functionality. A model whereby access to the digital euro is intermediated by the private sector is therefore preferable." (ECB, 2020b). It has also partnered with Bank of Japan in general exploratory efforts which emphasize "Balancing confidentiality and auditability in a distributed ledger environment."

Bank of Japan: The Bank of Japan announced a one-year trial of a digital yen (Ledger Insights, 2021), as follow on to its earlier position paper (Bank of Japan, 2020). There has also been joint work with the ECB as noted earlier.

China: Based on information that is publicly available, China's digital yuan is the most well-advanced among leading central banks. This is because of multiple factors. First, its progress in putting the CBDC into public use, efforts to integrate with leading social media offerings such as WeChat, and the breadth of its alliance making with other central banks, as exemplified by its recently announced m-CBDC effort, involving SAMA/UAE, Bank of Thailand, and HKMA.

Canada: Project Jasper is the Canadian banking industry's CBDC initiative. It was embarked upon in 2017, well before most other central banks were giving CBDCs the attention that they are now giving it. Participants in the project consisted of the Bank of Canada and private banks in Canada and were intended for inter-bank value or money transfer in a somewhat decentralized setting. In one of the initial phases, a private version of Ethereum was utilized. The project then moved to R3's Corda solution. In this latter phase, some degree of centralization was utilized in the form of a notary node operated by the Bank of Canada. The project utilized digital signatures to verify the authenticity of information. Privacy was maintained among members by participants only having access to transactions that were relevant to them. Private market participants used newly created objects called Digital Depository Receipts (DDR). These were created in exchange for Canadian Dollars. Both are central bank liabilities, but DDR was only valid within the scope and systems of Project Jasper.[5]

[5] Bank of Canada, 2017, 2019

Annals of Spiru Haret University.
Economic Series
Since 2000
ISSN:2393-1795 ISSN-L:2068-6900

Russia: The Bank of Russia has issued a position paper. It specifically calls for a two-tier system: "The selected target model is a two-tier retail model which assumes that the Bank of Russia is both the issuer of digital rubles and the operator of the digital ruble platform. At the same time, financial institutions open electronic wallets for their clients and perform operations over these wallets on the digital ruble platform. Households and businesses will be able to access their digital rubles through any bank where they are serviced."[6]

Non-Sovereign Actors

Bitcoin

Bitcoin's appeal starts with the fact that it already exists and has operated for over a decade. This is in contrast to almost every other digital currency which is still 'vapourware' and faces an uncertain path to market. Bitcoin has an easily recognizable brand, is already used by hundreds of millions of people and has a vibrant ecosystem of service providers. By virtue of being stateless, Bitcoin has a large "total addressable market."

Other aspects of the digital currency that some users may find appealing are its algorithmic (and capped) inflation schedule and censorship resistance. Bitcoin may therefore appeal to digital currency users who are wary of the motives by some countries in introducing CBDCs, such as new policy tools enabled by programmability, or economic surveillance.

That said, Bitcoin's decentralization has its drawbacks. Its throughput is extremely limited and the energy consumption (and environmental impact) of its consensus mechanism is can be considered severe. Having a fixed inflation schedule also makes it vulnerable to severe deleveraging during a crisis, a lesson from other forms of "hard money" that the crypto faithful have yet to learn.

Ethereum

In some ways, Ethereum begins where Bitcoin ends. One of Bitcoin's core elements is the "transaction out" or TXO. It is the subcomponent within the transaction that is ultimately spent or left alone. Bitcoin Core, the codebase that a node operator might run, comes with a set of operations that one might use to not just merely move TXOs around but to do some more complicated things with it. For example, one might, say, mandate that a TXO, after signing it and moving it

[6] Bank of Russia, 2021

Annals of Spiru Haret University.
Economic Series
Since 2000
ISSN:2393-1795 ISSN-L:2068-6900

another block, can only be spent after a certain number of blocks have transpired. This ability to script allows for some flexibility to users of Bitcoin but the actual possibilities are quite limited, especially when compared with the plethora of high and low-level programming languages that are available at present. To a programmer, it might appear like a limitation. And it is, by design.

This is where Ethereum comes in. It allows for a much richer set of instructions, including simple but dangerous things (in a decentralized setting) like "software loops". The notion here is that users of Ethereum can set up more complicated instructions that can be activated if someone "kicks off" the instruction set or perhaps because another set of instructions kicked off and so on. With layers and layers of abstraction, one then eventually ends up with smart contracts and decentralized exchanges.

However, this level of complexity comes with a cost. Bitcoin, in a way, gives equal weight to the price (in terms of satoshis/byte) regardless to differing instructions. This could not be allowed in Ethereum as it would allow for, among other things, malicious or harmful (though not intentionally malicious) instructions to execute. Ethereum miners have a limited supply of computing power and just like anything else in the world, to economize for a limited supply of something, a price is set. In this instance, the price of instructions is set using a term called "gas" fees. It is best thought of as the fee to execute instructions. If a sufficient amount of fees (in terms of Ether) is not sent with a set of instructions, then instruction stops - circumscribing the problem of malicious or otherwise harmful instructions.

Ethereum is also different from Bitcoin in other ways. Where Bitcoin evolves slowly but surely, Ethereum changes rapidly and sometimes it is not clear to users whether the changes are positive. A "full node" containing all of Bitcoin's transaction and block data occupies, at present, less than 400 GB of space. The corresponding node, an "archival node", occupies over 7TB of space. Finally, where one might not find a figurehead for Bitcoin (although some claim to be), one will find one in the persona of Vitalik Buterin for Ethereum.

Finally, Ethereum plans to be different from Bitcoin in other ways. It wishes to move to a Proof-of-Stake model of consensus as opposed to the Proof-of-work model that exists. It also wishes to use techniques like "sharding" that allows different functions to "shard" into smaller, so to speak, sub-chains while still being able to interact with other sub-chains. The path forward for Ethereum is exciting but also risky. Those two things, of course, go hand in hand.

Annals of Spiru Haret University.
Economic Series
Since 2000
ISSN:2393-1795 ISSN-L:2068-6900

Issue 2/2022

Stablecoins

Introduced to address some of the volatility of cryptocurrencies while maintaining most if not all of their "desirable" characteristics, stablecoins are tied to a conventional currency, such as the dollar, euro, or a basket of currencies. They purport to offer the stability and familiarity of a traditional currency with the frictionless and programmable promise of cryptocurrencies.

Tether is notable as being the largest stablecoin by market cap, and perhaps surprisingly as having the largest daily volume of any cryptocurrency, exceeding even that of Bitcoin and Ethereum.

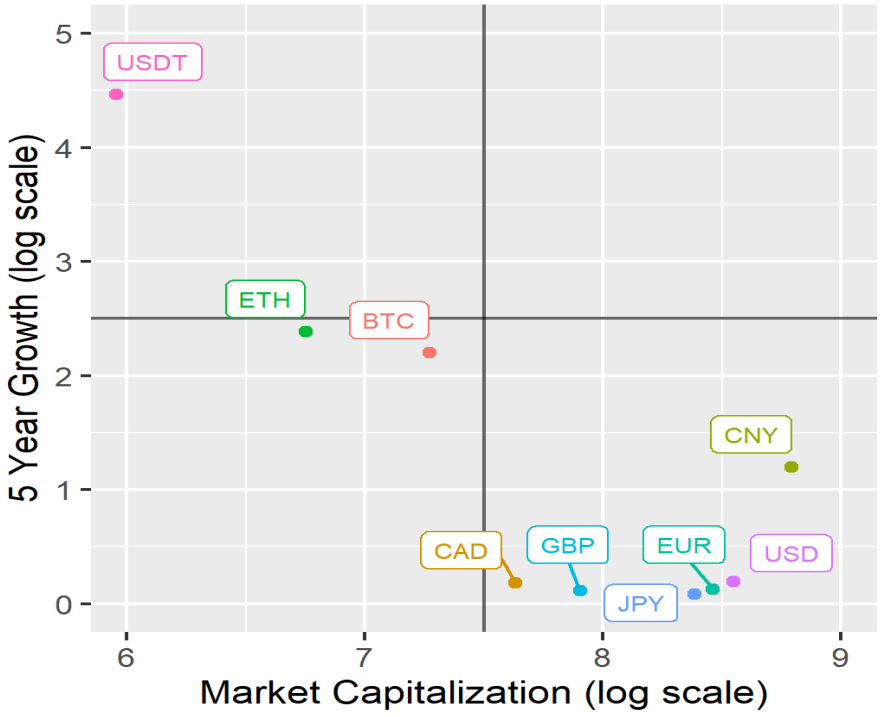

Figure 3. Market cap vs rate of growth.
Source: https://tradingeconomics.com

Annals of Spiru Haret University.
Economic Series
Since 2000
ISSN:2393-1795 ISSN-L:2068-6900
Issue 2/2022

The digital euro timeline

The timeline for a digital euro begins in a joint statement by the European Council and the European Commission on stablecoins in late 2019. The press release[7] noted that the then-recent rise of stablecoins underlined the significance of addressing consumer needs for fast, cost-effective, and efficient payments and cross-border remittances. The possibility of a CBDC to address these was also mentioned.

Christine Lagarde, president of the ECB, has laid the foundations for a digital euro in her speech at the Deutsche Bundesbank conference in September of 2020. It was highlighted the changing consumer sentiment towards digitalization, e-commerce, and electronic payments, further accelerated by the COVID-19 pandemic, along with the rising competition to dominate payments on a global level and Europe's disadvantaged position in the race. The issues of private money with weak connections to a sovereign counterpart, and mobile payments controlled by private firms, were also emphasized as a potential threat to financial sovereignty. A state-backed digital currency, widely trusted by the general public, was promoted as an option for managing the risks of this digital transition while maintaining trust in the existing payments system.

At the same time, the European Commission was adopting the Digital finance package to ensure competitiveness and stability in the Fintech sector. As part of that package, the Markets in Crypto-Assets Regulation addressed cryptocurrencies that fell beyond the scope of existing European legislation and introduced uniform rules for the treatment of stablecoins, leaving room for a pan-European sovereign deployment as a viable alternative. A month later, in October 2020, the ECB published the report on a digital euro.To date, this report constitutes the most comprehensive analysis of the motives behind a European CBDC and its desirable characteristics.

The analysis was released in conjunction with a request for public consultation on the characteristics of the digital euro. Following record participation of more than 8,000 citizens and institutions, the results went public in April 2021. The overwhelming majority of respondents promoted privacy and security as the two most desirable features of a digital euro, as collectively they were highlighted in more than 60% of responses. Accessibility throughout the euro area, no additional costs tied to the use of the new euro, and offline usability were also promoted as close runner-ups. The importance of intermediaries as facilitators of innovative services, smartphones for secure payments, and holding limits or other techniques

[7] European Commission, 2019

Annals of Spiru Haret University.
Economic Series
Since 2000
ISSN:2393-1795 ISSN-L:2068-6900

to manage the amount of digital euro in circulation, were also highlighted. The majority of respondents were men (87%), citizens of Germany (47%), Italy (15%), and France (11%), with the remaining Member States accounting for between 1% and 5% of the total.

Figure 2. Digital Euro Timeline.
Source: EUBOF

Implications of a digital euro for financial stability

The introduction of a CBDC creates two main risks for financial stability, linked to two different scenarios. The first risk is that of *financial disintermediation* in calm times. The second risk is represented by the possibility of *systemic bank runs* in times of financial distress.

The introduction of a CBDC may cause the withdrawal of funds from banks and their conversion into CBDC. This effect would be limited if households used CBDC mainly in substitution for physical cash. However, if commercial bank deposits were freely convertible into CBDC, households, and firms could be less willing to hold liquid money in the form of bank deposits and could prefer to hold CBDC instead. If this were the case, the substitution of bank deposits with CBDC would cause a loss of funding for commercial banks and a shrinking of the banking sector's balance sheet. This is precisely what "disintermediation" means[8].

[8] Bank of England 2020

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Economic Series
Since 2000
ISSN:2393-1795 ISSN-L:2068-6900

Therefore, the level of disintermediation caused by the introduction of CBDC is determined primarily by its substitutability with other forms of money. It is crucial to understand whether CBDC could be a substitute for cash, bank deposits, or both, and this, in turn, depends on the design features of CBDC.

Another very relevant factor in the disintermediation process is the behaviour of the central bank after a CBDC is introduced. In the following, we assume that the design of a CBDC is such that it does cause disintermediation. Not only could disintermediation occur after a CBDC is first introduced, but central bank money and commercial banks' money could be "structurally" pitted against each other. In other words, in normal times commercial banks would compete with the central bank to hold deposits. This effect would be reinforced if the central bank does not fill the funding gaps of commercial banks caused by disintermediation. The consequences of a CBDC would be both on banks' liability side and on their asset side. We can identify two main effects on the liability side.

First, banks could try to offer better conditions on their deposits, increasing deposit rates, to counter the conversion of bank money into CBDC. This would increase funding costs for banks and reduce their profit margin and seigniorage.

Second, banks may try to replace the deposits that are converted into CBDC with other types of funding, such as commercial paper, term deposits, bonds, and equity. This second option has three further implications:

- funding would likely become more expensive
- funding may become less stable
- market discipline may decline if banks lose more uninsured than insured depositors. This could push banks to take on more risk.

To sum up, if disintermediation is not adequately dealt with, it may cause an increase in the cost of banks' funding.

On the asset side, as a consequence of a higher cost of funding, banks would have to increase lending rates and transaction fees to maintain profitability. In the literature there is a variety of opinions on the overall effects of this process on lending activity. Many authors[9] envisage negative effects on lending activity by commercial banks. The effects on lending may also depend on banks' market power. The greater this power is, the less loan demand decreases, and the more

[9] Fernandez-Villaverde et al. 2020, Keister and Sanches 2019, Claeys and Demertzis 2019, Kim and Kwon 2019

Annals of Spiru Haret University.
Economic Series
Since 2000
ISSN:2393-1795 ISSN-L:2068-6900

banks can preserve profits. On the contrary, banks with little market power are forced to shrink their balance sheets and reduce loans.

A very important variable in the disintermediation process is also the stance of the central bank. A relevant role is played by the spread between the interest rate on CBDC and on checkable deposits. If this spread is positive and too large, banks end up reducing their loans.

In times of financial distress, households and firms tend to convert their deposits into safe assets and cash, with possible ensuing bank runs. A CBDC, being a liability of the central bank, would have a higher degree of safety with respect to bank deposits. Therefore, in a situation of financial distress, it could facilitate bank runs in a digital form.

There is not full agreement on this issue in the literature. Some authors argue that a CBDC would allow runs towards the central bank with "unprecedented speed and scale"[10], while others think that "in many cases, this effect will be muted"[11]. In any case, the design of a CBDC plays a key role in this situation as well.

Moreover, in times of financial distress, a CBDC can also play an active role, providing to the central bank some useful instruments. In particular, it may facilitate the provision of liquidity to banks, helping to calm down bank runs. The onset of a digital bank run may also act as a signal for the central bank to understand the conditions of the financial system and provide a fast and effective response[12].

The biggest financial stability issues are disintermediation and the increased risk of bank runs. However, other minor questions related both to stability and integrity must not be overlooked.

The effects of CBDC on financial integrity depend on its design. Strict limits on the size of transactions, coupled with facilitation of identity authentication and tracking of payments and transfers would strengthen financial integrity. Moreover, if it is account-based, a CBDC could help prevent illicit payment and store of value with central bank money. On the other hand, a design that allows for full anonymity and large-value transactions would undermine financial integrity. Once again, we can see that the effects of a CBDC on the economy inevitably depend on

[10] CPMI-MC, 2018
[11] Mancini-Griffoli et al. 2018
[12] Keister and Monnet 2020

Annals of Spiru Haret University.
Economic Series
Since 2000
ISSN:2393-1795 ISSN-L:2068-6900
Issue 2/2022

its concrete design, which has to be planned according to policy preferences, without overlooking real-world impacts.

If the CBDC is designed in such a way as to preserve anonymity and hence facilitate cross-border payments, its adoption would greatly increase the volatility of international capital movements. Indeed, if we take into account the international environment, very large net cross-border movements of CBDC may not only complicate the conduct of monetary policy but also undermine financial stability. CBDC could, in some situations, lead to large capital movements, exchange rate disturbances and asset price volatility. The effects of cross-border CBDC movements would be especially pronounced during times of generalized flight to safety. Indeed, using a CBDC as an international currency could potentially enable faster deleveraging in capital markets, accelerating cross-border contagion and amplifying exchange rate fluctuations.

Conclusions

Central Bank Digital Currencies are the natural next step in the digitization of money and payment systems. Given the momentum and initiatives already underway worldwide, we cannot imagine a scenario where different forms of CBDCs do not co-exist with other forms of money in the near future.

Europe, as one of the world's largest and most innovative economies, is an important contender in the race to design, implement and deploy the digital money of the future. The European Central Bank is leading this effort as part of its mission to keep prices stable in the euro area and contribute to the safety and soundness of the European banking system.

To contrast the risks of financial disintermediation, electronic bank runs and other potential threats to financial stability raised by the introduction of CBDCs, several solutions could be on the table. Some of them are not related specifically to CBDCs, but consist of more traditional measures (such as lender of last resort and deposit insurance). We shall therefore not discuss them here. Others, instead, involve specific design features of the CBDC, such as:

1. lower remuneration of CBDC with respect to other policy rates - remunerating a retail CBDC could make it even more competitive with respect to bank deposits and government bonds. Therefore, it could end up reducing the quantity of bank lending to the economy and even interfering with the role of government debt as a safe asset.

Annals of Spiru Haret University.
Economic Series
Since 2000
ISSN:2393-1795 ISSN-L:2068-6900

2. limited convertibility of CBDC - some scholars think that limited convertibility of CBDC with other assets could prove effective in countering financial stability risks. The "light" approach is to discourage convertibility from bank deposits to CBDC through fees. The "hard" approach is to break the link between CBDC and other forms of money. CBDC and reserves would be distinct, and not convertible into each other.

3. cooperation of the central bank with commercial banks in relation to the issuance of CBDCs - the central bank could structurally provide more funding to commercial banks to replace the lost deposits or an alternative solution is the creation of an indirect CBDC, instead of a direct one. The central bank would not provide CBDC directly, but indirectly.

4. control of CBDC volumes.

An ECB-issued digital euro would go a long way toward facilitating payments efficiency and security across the eurozone, furthering financial inclusion, and futureproofing the euro against developments in other economic jurisdictions (e.g. the USA and China) and non-sovereign implementations of private or decentralized forms of digital money (e.g. Diem or cryptocurrencies). The speed of innovation by other actors is relentless and a global race to define the world's reserve currency of the digital era is well underway. Europe cannot afford to not be part of this effort, by both closely monitoring global developments and innovating across dimensions specific to the idiosyncrasies of the eurozone.

References:

[1] ACI Worldwide (2020) COVID-19 Crisis Drives Changes in eCommerce Purchasing Behaviors, ACI Worldwide Research Reveals | ACI Worldwide, Inc.
[2] Adrian, T. and Mancini-Griffoli, T. (2019), The rise of digital money. Washington, DC: International Monetary Fund.
[3] Areddy, J. T. (2021) 'China Creates Its Own Digital Currency, a First for Major Economy', Wall Street Journal, 5 April.
[4] Auer, R., Cornelli, G. and Frost, J. (2020) 'Rise of the central bank digital currencies: drivers, approaches and technologies', p. 44.
[5] Bank of England (2020a) 'Discussion Paper - Central Bank Digital Currency: Opportunities, challenges and design', p. 57.
[6] Bellens, J., Lloyd, J. and Hamish, T. (2020) Why the potential end of cash is about more than money | EY - Global.
[7] ECB (2020a) 'Payments in a digital world'.

[8] Federal Reserve Bank of Boston (2020) The Federal Reserve Bank of Boston announces collaboration with MIT to research digital currency, Federal Reserve Bank of Boston.
[9] Simmons, R. et al. (2021) 'Crisis and the Role of Money in the Real and Financial Economies – An Innovative Approach to Monetary Stimulus', Journal of Risk and Financial Management, 14(3), p. 129.
[10] Visco, I. (2020) 'The role of TIPS for the future payments landscape'.
[11] Werner, R A (2014). Can banks individually create money out of nothing? — The theories and the empirical evidence. International Review of Financial Analysis, Vol 36, pp 1-19.
[12] Wilson, T. (2021) China's digital yuan will not topple the dollar, SEC official says, Reuters.

Websites:
https://www.consilium.europa.eu/el/press/press-releases/2019/12/05/joint-statement-by-the-council-and-the-commission-on-stablecoins
https://www.ecb.europa.eu/press/key/date/2020/html/ecb.sp200910~31e6ae9835.en.html
https://www.federalreserve.gov/faqs/what-economic-goals-does-federal-reserve-seek-to-achieve-through-monetary-policy.htm
https://www.weforum.org/whitepapers/inclusive-deployment-of-blockchain-for-supply-chains-part-6-a-framework-for-blockchain-interoperability
https://en.wikipedia.org/w/index.php?title=Diem_(digital_currency)&oldid=1022940118