

Central Bank Digital Currencies – Status quo, evolutions and possible variants of implementation

Jäger, Clemens¹ – Akbay, Serkan² – Jäger, Tina³ – Ledwon, Andreas⁴

Abstract: The development in payment behavior, especially the steady growth of electronic pay-ments, by all economic actors as well as the emergence of alternative payment methods has pushed policy makers and central banks to react to this development. CBDCs are currently being conceptually developed in all major economies and the individual design options are being discussed. This paper presents the current status quo, possible forms of development and the possibilities of implementation.

Keywords: CBDC, central bank digital currency, digital currencies, cryptocurrencies

JEL Codes: A11, D14, E42, E58

*“Let me issue and control a nation's money and I care not who writes the laws.”
Mayer Amschel Rothschild*

¹ Prof. Dr. Clemens JÄGER Professor and Dean
(<https://orcid.org/0009-0002-9761-3032>),
FOM – University for Economics and Management in Essen, Germany
(clemens.jaeger@fom.de)

² Prof. Dr. Serkan AKBAY Professor
(<https://orcid.org/0009-0006-0941-8261>),
FOM – University for Economics and Management in Essen, Germany

³ Prof. Dr. Tina JÄGER Professor
(<https://orcid.org/0009-0005-8951-2639>),
FOM – University for Economics and Management in Essen, Germany

⁴ Dr. Andreas V. LEDWON Research Fellow
(<https://orcid.org/0000-0002-4406-8280>),
FOM – University of Applied Sciences for Economics and Management, Germany

How sustainable is the development in favor of CBDCs?

Central Bank Digital Currencies (=CBDC) can be defined in simplified terms as follows: “In simple terms, a central bank digital currency (CBDC) would be a digital banknote. It could be used by individuals to pay businesses, shops or each other (a “retail CBDC”), or between financial institutions to settle trades in financial markets (a “wholesale CBDC”).” (Bank for International Settlement (BIS), 2023).

For the sake of simplicity, the public often uses terms such as digital U.S. dollar, digital euro, or digital yuan, depending on the country or region currently being discussed. The result is that these are also CBDCs, although there is usually no differentiation between “retail” and “wholesale”. This differentiation is more likely to be found at the level of trade publications. The said public is generally unaware of the significant developments that are currently taking place in relation to CBDCs. In order to close this particular knowledge gap, the following figure may help as a first step.

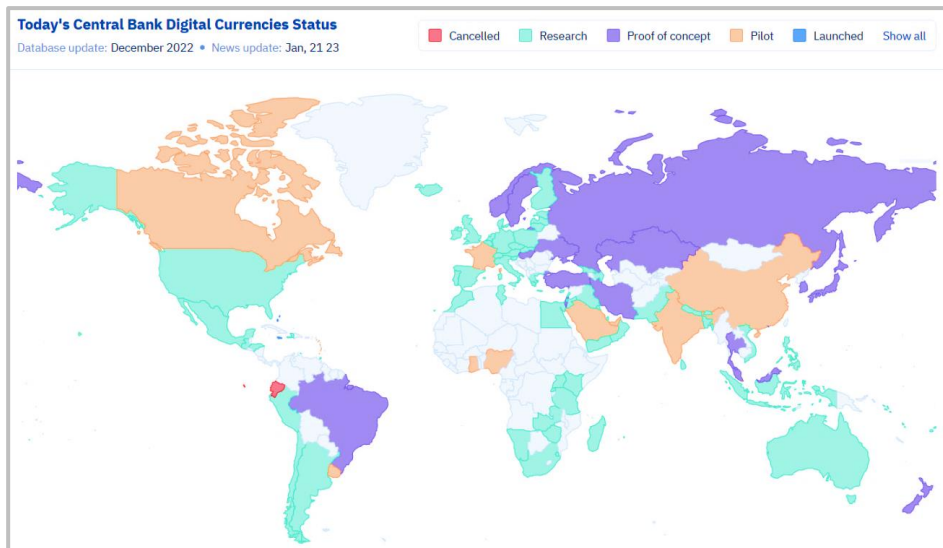


Figure 1: Development of CBDCs worldwide

Source: CBDC Tracker, 2023

The figure clearly shows that a large number of the world's central banks are working intensively on the topic of central bank digital curren-

cies at various stages of development. This development ranges from research to concept testing of pilot studies, to de facto implementation (Atlantic Council, 2023a; Atlantic Council, 2023b). So, each gray highlighted country on the map is in one of these different stages. This is all the more remarkable given that the world in 2023 shows little unity in many other areas. This ranges from economic disputes between the U.S. and China to war between Russia and Ukraine. But regardless of political persuasion, economic system and associated ideologies, CBDCs are apparently a topic in which at least a large number of countries are showing great interest and are investing corresponding funds in research and development (Bank of Canada, 2023; CRYPTO BRIEFING, 2023).

Overview of major CBDC stakeholders

Significant stakeholders who also repeatedly speak publicly on the subject of CBDC include, among many others, the:

- US govt = United States Government
- BIS = Bank for International Settlements
- ECB = European Central Bank
- GB govt = Great Britain Government
- IMF = International Monetary Fund

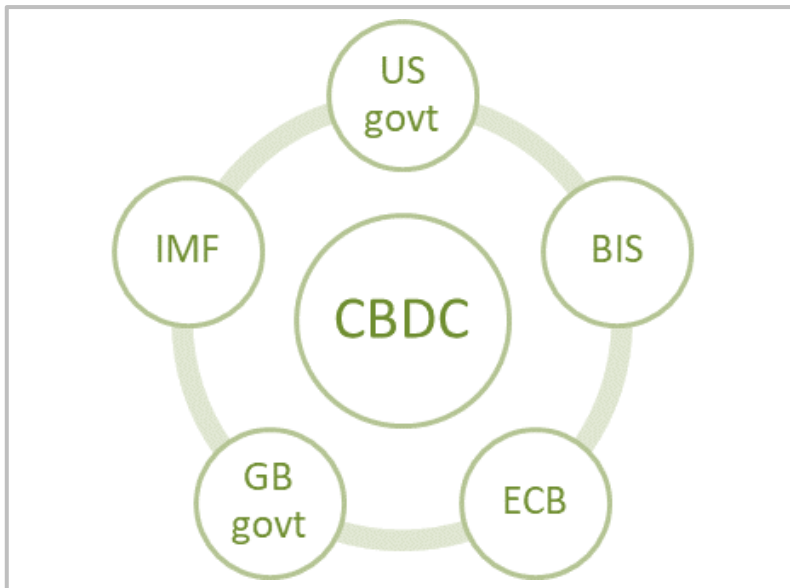


Figure 2: Overview of selected stakeholders in the context of CBDCs

Source: Own figure

In recent years, these stakeholders have expressed themselves on the subject of CBDCs with varying and sometimes remarkable clarity. These statements, in turn, allow conclusions to be drawn about the perspectives, motivations and attitudes of the stakeholders on the topic and, in some cases, very clearly show what intentions are present. By documenting these statements, it should be made clear in the following that although Figure 1 clearly reflects the current development of CBDCs, this can also be backed up with concrete statements from the relevant representatives of individual stakeholders. It should be noted at this point that there are also many critical voices on the subject of CBDCs and to date the further development of CBDCs cannot be deduced with certainty.

Statements from key CBDC stakeholders

In the following, the statements of individual representatives of the stakeholders mentioned (see *Figure 2*) will be quoted. These statements paint a picture of the current attitude of leading politicians or institutions towards the topic: CBDCs. After studying these statements and in connection with Figure 1, there can hardly be any doubt about the seriousness and determination to intensively research CBDCs in the coming years and to implement them if necessary. The concrete form in which this implementation can take place is then revealed in the following chapter of this article.

USgovt

U.S. Treasury Secretary Janet Yellen has spoken out on the subject of CBDCs. She said in the context of the “DealBook DC Policy Project” that with the help of CBDCs “faster, safer and cheaper payments” (Yellen, 2021) could be possible. Then, in March 2022, an Executive Order was published by U.S. President Joe Biden (The White House, 2022a). This Executive Order was supplemented in September 2022 by a factsheet (The White House, 2022b). Even if it is repeatedly pointed out that there are still many open questions around CBDCs to be clarified, highly interesting formulations can be extracted from these publications. Here, first of all, the reference to the Executive Order:

- “My Administration places the highest urgency on research and development efforts into the potential design and deployment options of a United States CBDC” (The White House, 2022a).

- “My Administration sees merit in showcasing United States leadership and participation in international fora related to CBDCs...” (The White House, 2022a).
- “Any future dollar payment system should be designed in a way that is consistent with United States priorities ... and democratic values...” (The White House, 2022a).

The following statements can be found in the supplementary fact-sheet:

- “...the reports encourage the Federal Reserve to continue its ongoing CBDC research, experimentation, and evaluation and call for the creation of a Treasury-led interagency working group to support the Federal Reserve’s efforts” (The White House, 2022b).
- “A U.S. CBDC – a digital form of the U.S. dollar – has the potential to offer significant benefits. It could enable a payment system that is more efficient, provides a foundation for further technological innovation, facilitates faster cross-border transactions, and is environmentally sustainable. It could promote financial inclusion and equity by enabling access for a broad set of consumers. In addition, it could foster economic growth and stability, protect against cyber and operational risks, safeguard the privacy of sensitive data, and minimize risks of illicit financial transactions. A potential U.S. CBDC could also help preserve U.S. global financial leadership and support the effectiveness of sanctions” (The White House, 2022b).
- “Recognizing the possibility of a U.S. CBDC, the Administration has developed Policy Objectives for a U.S. CBDC System, which reflect the federal government’s priorities for a potential U.S. CBDC” (The White House, 2022b).

BIS – Agustin Carstens

In 2020, the General Manager of the Bank of International Settlements, Agustin Carstens, made very clear and transparent comments on the subject, including the following: “We don’t know who’s using a \$100 bill today and we don’t know who’s using a 1,000 peso bill today. The key difference with the CBDC is the central bank will have absolute control on the rules and regulations that will determine the use of that expression of central bank liability, and also, we will have the technology to enforce that” (Carsten, 2020).

Already in 2019, Agustin Carstens was comparably clear here: “We can see how cash compares with a retail CBDC in the last two columns in *Table 1*. Like cash, a CBDC could and would be available 24/7, 365 days a year. At first glance, not much changes for someone, say, stopping off at the supermarket on the way home from work. He or she would no longer have the option of paying cash. All purchases would be electronic. But from here, differences start to emerge. A CBDC is not necessarily anonymous, like cash. And unlike cash, it could pay or charge interest” (Carstens, 2019).

From these statements by Agustin Carstens, one can see the extent to which the development of CBDCs is already operationalized.

ECB – Christine Lagarde

Christine Lagarde, President of the ECB made the following comments on CBDC in March 2022:

“On your question concerning CBDC, you know my views on CBDC and you know that I have pushed that project. Fabio Panetta is working hard on that together with members in the entire Eurosystem with the high-level taskforce that is working really hard on moving forward. But in a way, I am really pleased that attention is now focussed on the role that cryptos can play and the role that Central Bank Digital Currency can have when they are implemented. We have a schedule, as you know. The Governing Council decided back in October '21 to launch a two-year investigation phase, and it is at the end of that investigation phase that the decision will definitely be made to launch the CBDCs and to make it a reality. We can't go wrong with that project. I am confident that we will move ahead, but that's going to be a decision of the Governing Council. I think it's an imperative to respond to what the Europeans expect, and I think we have to be a little bit ahead of the curve if we can on that front.

If we can accelerate the work, I hope we can accelerate the work. I will certainly support that, and I was delighted to see that in the United States there was an executive order by President Biden to actually expect similar effort and focus and progress on CBDC, cryptos. I think that it will take all the goodwill of those who want to support sovereignty, who want to make sure that monetary policy can be transmitted properly using our currency, will endeavour” (Lagarde, 2022).

Like Augustine Carstens, Christine Lagarde cannot be accused of being non-transparent or reticent about her attitude towards CBDCs. Statements like: “when they are implemented” (Lagarde, 2022), “We can't go

wrong with that project”. (Lagarde, 2022) Or also “I am confident that we will move on...” (Lagarde, 2022) speak a very clear language, even for politicians.

GBGovt – Rishi Sunak

The current Prime Minister of Great Britain and then Finance Minister Rishi Sunak is certainly one of the ambassadors for the research, development and implementation of CBDCs with the following statement:

“Today I’m proud to say that under the UK’s presidency the group of the world’s seven most advanced economies the G7 is launching a set of public policy principles for retail central bank digital currencies (CBDC’s). Central bank digital currencies could be a digital version of money. A bit like a digital banknote that could be used alongside physical notes and coins. Unlike most of the digital money people use daily today, it would be issued directly by a central bank like the bank of England in the UK. And governments and central banks across the world are working together, looking into what having a digital currency might mean in practice. This includes issues that people care about, such as ensuring users money would be safe and secure, that it could work with other ways to pay. Would be energy efficient and available to everyone. A potential CBDC could offer businesses and consumers new ways to pay in the future. It’s all part of the wider story of digital innovation that has delivered benefits to millions around the world and in the UK. The decision on whether to launch a central bank digital currency is for each country to make, and no G7 jurisdiction has yet made that choice. These decisions raise important questions about the reshaping of our economy, financial systems and the way in which people interact with money and payments. That’s why working together and careful evaluation with our international partners is essential. In the UK earlier this year I announced a new joint task force between the Treasury and the Bank of England to look into a potential CBDC as a complement to cash and bank deposits, we’re also hearing from firms, technology experts and others. Under the leadership of the UK this report today will help support and inform exploration of CBDC’s in the G7 and beyond. With these principles the G7 is leading an important step change in the global policy conversation. The report covers a range of important matters such as financial stability, cyber resilience, energy efficiency, privacy, inclusion and tackling illicit finance. These factors should all be considered when designing and potentially delivering a CBDC that would be fit for the future. Our shared objective is to ensure

that CBDC's will be grounded in long-standing commitments to transparency, the rule of law and sound economic governance the G7 will continue its work in this important area working with others to enhance understanding and use of these principles. We're excited to be taking a leading role with g7 members in publishing this exploratory work bringing money and finance into the 21st century” (Sunak, 2022).

IMF – Bo Li

Bo Li, as Deputy Managing Director of the IMF, has already provided another important explanation. He explained that CBDCs can be used as programmable money and that this can lead to a very targeted promotion of individual groups of people and thus, if necessary, of individual sectors of the economy. In this context, Bo Li also explicitly addresses the notion of “financial inclusion.” This term is regularly used by proponents of CBDCs. Whether this “financial inclusion” actually promotes only positive results remains to be seen and should be critically scrutinized in the meantime.

“The third way we think CBDC can improve financial inclusion is through what we call programmability. That is CBDC can allow government agencies and private sector players to program to create smart contract, to allow targeted policy functions. For example, welfare payment, for example consumption coupon, for example food stamp. By programming CBDC those money can be precisely targeted for what kind of people can own and what kind of use this money can be utilized, for example for food. So, this potential programmability can help government agencies to precisely target their support to those people who need support. So that way can also improve financial inclusion. Of course, I want to end with a caveat because CBDC is not a Panacea. CBDC cannot solve every challenge in financial inclusion. There are some aspects of financial inclusion is not related to technology for example financial literacy, digital literacy. So CBDC has to work with other policies together to try to improve financial inclusion. I stop here” (Li, 2022).

All in all, the statements compiled show that CBDCs are already very important today, as shown in *Figure 1*, and that many people in positions of responsibility - at central points in the financial system - already have a very positive attitude toward them. In the following chapter, a closer look is taken at the different implementation options in order to generate a basic understanding of the further development possibilities.

Variants of implementation

Based on the developments of cryptocurrencies, the following characteristics have been attributed to them: (I) Electronic, (II) Decentralized, and (III) Peer-to-peer transfer (Bech–Garratt, 2017). Cryptocurrencies combine these properties (see left panel in *Figure 3*). Bjerg further developed the money taxonomy with respect to CBDC and formulated the required properties of (I) Electronic, (II) Universally Available, and (III) Issued by the Central Bank (Bjerg, 2017). As can be seen in the right part of the following figure, CBDCs combine these properties.

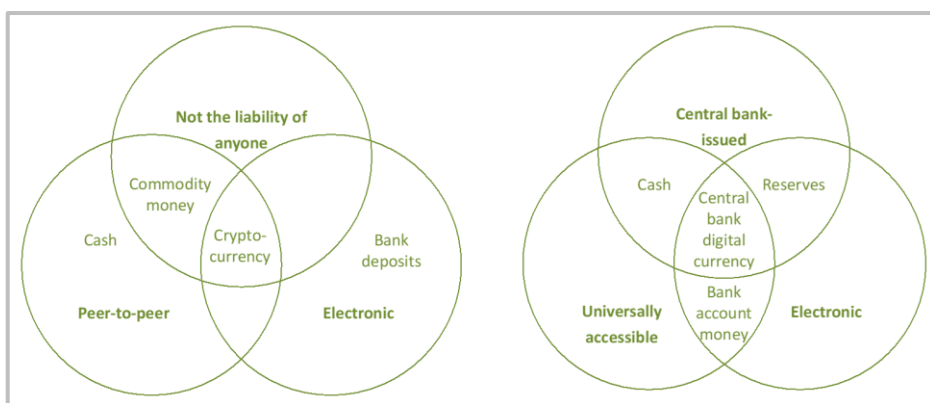


Figure 3: Money taxonomy

Source: Bech–Garratt, 2017; Bjerg, 2017

To illustrate the conflicting objectives of the monetary properties within the current types of money (cash, commercial bank money and central bank reserves), cash serves as a relevant reference example: Cash is accessible to everyone (no access or exit restrictions) and thus satisfies the requirement of universal availability (De Nederlandsche Bank, 2023). Moreover, cash is issued by the central bank (Deutsche Bundesbank, 2021a; Deutsche Bundesbank, 2021b), so that cash is understood as the overlap of the properties (II) universal availability and (III) issued by the central bank. The money property: “electronics of money” does not apply to cash, since it is a physical form of money. In this respect, two of the three money properties are fulfilled in the case of cash. It shows up that CBDCs all three characteristics in itself unites and thus as starting point for further considerations in the conceptual design of the CBDC form of money is to serve.

Bech and Garratt (2017) further developed the money taxonomy (*Figure 3*) in the context of central bank cryptocurrencies (CBCC), identifying the determinants of issuer (central bank or other institutions), form (electronic or physical), availability (universal or restricted), and transmission mechanism (central vs. decentralized [peer-to-peer]) and combining them into a “money flower”. Although the “money flower” was created in the context of Central Bank Cryptocurrency as a precursor to CBDCs, the characteristics and structure can be applied to the conceptual considerations of CBDCs.

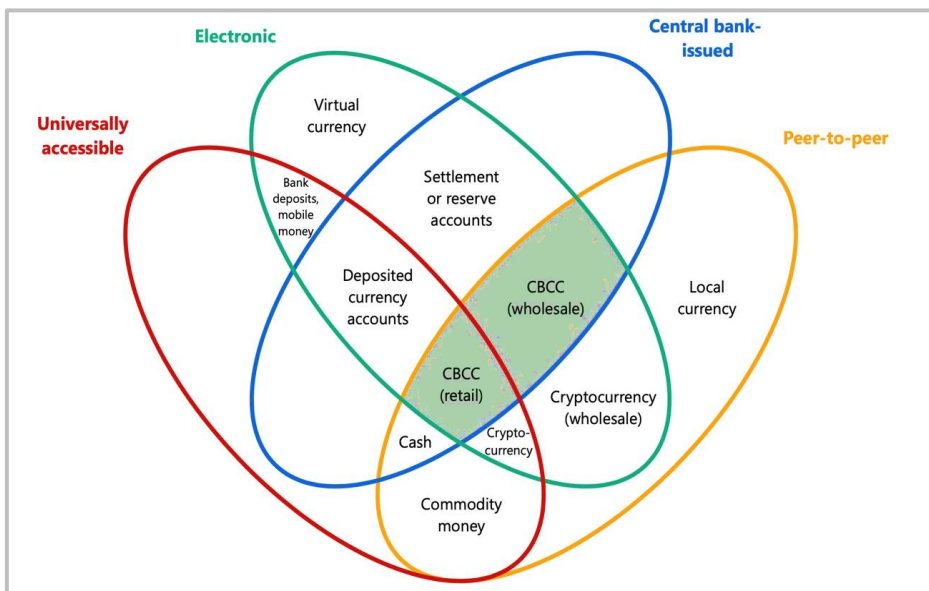


Figure 4: Money flower

Source: Bech–Garratt, 2017

The “money flower” shows that the current forms of money and possible CBCC or CBDC types take different account of the four attributes. For example, the unchanged preferred form of money, cash, is available to everyone for retail payments (European Central Bank, 2023b) [even though there are signs of a downward trend (Bank for International Settlements, 2021; Ahnert et al., 2022; Zamora-Pérez, Coschignano-Barreiro, 2022; Bindseil–Panetta–Terol, 2021)], is issued by the central bank and can be transferred directly (peer-to-peer). However, the electronic attribute is missing here. With a view to the intended further development of the monetary system while maintaining centrality, the four forms of

money in the ellipse Central bank-issued are worth explaining. The deposits held by commercial banks at the central bank are referred to as settlement or reserve accounts (European Central Bank, 2023a). Characteristic of this is the electronic form of money and the mandatory property issuance from the central bank. However, this form of money is not available to everyone (but only to commercial banks) and direct interaction among commercial banks is not possible either, as the central bank acts as an intermediary here. Previously theoretically conceivable were Deposits Currency Accounts (DAC = accounts held directly with the central bank) (Tobin, 1987), which combine 3 attributes (universal availability, electronic and issued by the central bank) (Tobin, 1987; Bech–Garratt, 2017). However, direct interaction between account holders is not possible here either, as the central bank also acts as an intermediary. The current cryptocurrencies also do not combine all the desired attributes (universal availability is basically given, the electronic form of the currency and a peer-to-peer mechanism is given, but the centrality by the central bank is missing here). An overlap of all attributes is found in the CBCC (retail) or CBDC form of money. This form of money is available to everyone, can be handled electronically, guarantees direct transfer without an intermediary (peer-to-peer) and is also issued by the central bank (Bech–Garratt, 2017). CBCC (wholesale) primarily serves large financial institutions and is thus limited in terms of general availability. In conclusion, both the retail and wholesale variants of the CBCC have the greatest possible overlap and will be explained in more detail below.

It should be noted at the outset that central banks want to consider the three foundational principles in CBDC creation and implementation: (I) do not harm, (II) coexistence, and (III) innovation and efficiency (Bank for International Settlements, 2020). From these principles, the Bank for International Settlements derives the following characteristics for CBDCs.

Table 1: Core CBDC features

| Instrument features | System features | Institutional features |
|---|--|---|
| <ul style="list-style-type: none"> • Convertible • Convenient • Accepted and available • Low cost | <ul style="list-style-type: none"> • Secure • Instant • Resilient • Available • Throughput • Scalable • Interoperable • Flexible and adaptable | <ul style="list-style-type: none"> • Robust legal framework • Standards |

Source: Bank for International Settlements, 2020

The above characteristics in *Table 1* should be considered for both retail CBDCs and wholesale CBDCs, which will be presented later. Some institutions, such as the Deutsche Bundesbank, are currently still in the proof of concept phase (2021 to 2023), with the aim of investigating the design options and their impact of the digital euro (Balz, 2021). The two main approaches, retail CBDC and wholesale CBDC, are therefore examined in more detail below.

Retail-CBDC

The primary objective of the retail CBDC variant is to be a digital alternative to cash (Klein–Groß–Sandner, 2020). A retail CBDC is therefore a digital banknote (Bank for International Settlements, 2023). The four attributes of the “money flower” are fully taken into account in a retail CBDC (Bech–Garratt, 2017). Retail CBDC is thus electronic money, issued by the central bank, enables a peer-to-peer transaction and is available to everyone (UK Finance, 2021). One embodiment of retail CBDCs could be accounts held by individuals or companies directly with the central bank (Bindseil, 2020). Retail CBDC involves many stakeholders, such as legislators, payment system providers, and the public (individuals and businesses) (Panetta, 2022). To ensure technical implementation and maintenance of the retail CBDC system, third-party providers could take on the associated tasks for a fee (Bindseil, 2020). Alternatively, a token model is conceivable, particularly to address concerns about loss of anonymity in accounts held directly with the central bank (Bindseil, 2020). This approach is decentralized (Bech–Garratt, 2017), represents a claim on the central bank (Armeliuss–Claussen–Hull, 2021), and is, however,

contrary to the original objective (as described earlier). The token approach is similar to today's cash in that anonymity is preserved here (Wagenknecht, 2022) and ultimately it is the payee and not a central institution that verifies the authenticity of the money (Bech–Garratt, 2017). Therefore, the token definition from the Swedish National Bank's report is used: “A CBDC token is a digital object that (I) has a given value expressed in the national unit of account and (II) is a claim on the respective central bank” (Armeliu–Claussen–Hull, 2021). Within the token-based CBDC variant, a differentiation is also made between different token approaches (remote stored CBDC token vs. locally stored CBDC token) (Armeliu–Claussen–Hull, 2021). Here, however, the current inefficiency of some distributed ledger technologies (DLT) networks (A Distributed Ledger (DL) or Distributed Account Book is generally referred to as a spread database that allows members of a network to share write, read, and store permissions. Deutsche Bundesbank, 2017) due to high energy consumption or governance provisions within the network by unknown network participants must be viewed critically (Panetta, 2022). Nevertheless, the following advantages of retail CBDCs can be seen:

One of the main advantages of retail CBDC is efficiency: payments can be processed faster, more cheaply and more securely (UK Finance, 2021; Bindseil, 2020) and is all the more advantageous given the current process time of several days for cross-border payments (Deutsche Bundesbank, 2023a). In addition, greater transparency makes it easier to combat financially illegal activities (Bank for International Settlements, 2020; UK Finance, 2021). Since central banks are a crucial entity in the centralized system, monetary policy can be better managed through real-time data of money in circulation (UK Finance, 2021). However, risks are also seen, as CBDCs can tangentially affect an individual's personal spheres because central banks have a detailed overview of citizens' payment behavior and spending (UK Finance, 2021). Since it is an exclusively digital money variant, it is ultimately also not free from possible cyber attacks (UK Finance, 2021). Furthermore, it should be noted that the current banking system eliminates the need for account management in the commercial banking sector by having accounts held at the central bank, which could encourage bank-run developments (Bindseil–Panetta–Terol, 2021; Committee on Payments and Market Infrastructures, 2018). Furthermore,

the banks' revenue stream 'income from payment processing' could collapse due to the migration of accounts from the commercial banks to the central bank (Committee on Payments and Market Infrastructures, 2018).

Wholesale-CBDC

The wholesale variant could be characterized by the fact that the current central clearing system would be converted to a decentralized peer system, which would primarily affect interbank trading and the market between financial institutions (Klein–Groß–Sandner, 2020; Bank for International Settlements, 2023; Digital Euro Association, 2023). In order to provide a classification of wholesale CBDC, reference is made to explanations by Fabio Panetta (member of the ECB Executive Board). Wholesale CBDC has existed for decades in the context of transaction settlement of central bank reserves between banks; for example, commercial banks have been using the TARGET system for decades using central ledger technology for central bank money transfers (Panetta, 2022). The scope of participants is limited to users of “...central bank settlement infrastructures... such as banks or central securities depositories” (Panetta, 2022). The current wholesale CBDC system is to be adjusted by distributed ledger technology (DLT), since in a DLT there is no central entity in a network (Bundesamt für Sicherheit in der Informationstechnik, 2019; Bech–Garratt, 2017). Further development of the current central bank money transfer can be token or non-token based (as is currently the case), as with retail CBDC (Finextra, 2019). A wholesale CBDC token also presents a claim against the issuer here, so ultimately the creditworthiness of the issuer may have an impact on the token value (Committee on Payments and Market Infrastructure, 2019). The extent to which a DLT will be used in the context of wholesale CBDC is currently still being investigated (e.g. by the ECB) (Panetta, 2022). The relevance of wholesale CBDC is illustrated by the “Project Jura” experiment of the Banque de France, Bank for International Settlements and the Swiss National Bank, which are evaluating the transfer of euros and Swiss francs between commercial banks on a wholesale CBDC basis (Banque de France, Bank for International Settlements & Swiss National Bank, 2021). Within the ECB, two options are currently being analyzed: The integration of DLT networks into the central bank infrastructure and the complete redevelopment of a DLT platform (Panetta, 2022). In this respect, the considerations in the design and implementation of wholesale CBDCs have not been completed.

Now, it is significant to look at the issue of CBDCs systemically and not in isolation. For this reason, the following chapter will take a look at the latest development toward a uniform digital identity. This development in conjunction with CBDCs and the increasing importance of artificial intelligence have tremendous potential for change.

Digital Identification

According to Article 6 of the Universal Declaration of Human Rights “everyone has the right to recognition everywhere as a person before the law” (United Nations General Assembly, 1948). As a matter of fact, being able to prove who you are is not only a human right but also offers each person access to our society and economy and its related services, such as opening a bank account, receiving state aid payments, or applying for a formal employment. However, not every person is in possession of any form of legally recognized identification and hence this feature heavily impacts a person’s inclusion in economic, social, and political interactions (White et al., 2019).

Although there are already prominent examples of well-functioning Digital Identification (ID) systems in place, such as the e-ID in Estonia or the Aadhaar government programme in India (White et al., 2019), according to the World Bank’s ID4D database, approximately one billion people over the world do not have any form of legally recognized identification. Another 3.4 billion people possess a type of legally recognized identification and have limited ability to use it in the digital world. The remaining 3.2 billion have a legally recognized identity and participate in the digital economy but may not be able to use that ID effectively and efficiently online (White et al., 2019).

In contrast to paper-based identification, such as passports, birth certificates, or even driver’s licenses, a digital identification, also referred to as “digital ID,” can be solely authenticated through a digital channel (White et al., 2019; Lahmann, 2022).

On a global scale, the organization ID2020 in New York is working on a transnational digital identity for everyone, which should incorporate as much data as possible. ID2020 is an alliance of high-tech corporations such as Microsoft, IT consulting company Accenture, the Rockefeller Foundation, the Bill Gates-funded vaccination alliance GAVI, or IDEO ORG which is linked to the medical industry (ID2020 Alliance Partners,

2023). Originally, the alliance was formed to assess and verify the vaccination status during COVID-19 of international travelers (Lahmann, 2022). The cooperation partners and supporters include i.a. the US government, the EU Commission, and the UN refugee agency UNHCR (ID2020 Alliance Partners, 2023; Häring, 2022). The organization's goal is that every person should be able to identify themselves until 2030 (Lahmann, 2022) with biometrical data and release voluntarily personal information on request (Lahmann, 2022).

In line with the global goal of ID2020, the president of the Commission, Ursula von der Leyen, fostered in her speech on September 16, 2020 with the title Building the world we want to live in: A Union of vitality in a world of fragility, that the Commission will be proposing a secure European digital identification which will be offered to all EU citizens, residents, and businesses in the EU allowing services ranging from securely and transparently paying taxes to even renting cycles on a daily basis in the EU (von der Leyen, 2020). One year later, in 2021 the Commission proposed a framework for a European Digital Identity (European Commission, 2021). This European digital identity will be available to anyone who wants to use it, allowing secure and transparent usability, and enabling users to control their personal data (European Commission, 2023a). As a subsequent step, all member states were invited to propose suitable tools and approaches, such as the technical architecture, standards, and guidelines by September 2022 (European Commission, 2021). The European Digital ID is part of the Commission's 2030 Digital Compass and highlights the development of a national digital ID is just a recommendation for Member States (European Commission, 2021). Most recently in January 2023, four of the leading telecommunication companies in Europe (Deutsche Telekom AG, Orange S.A., Telefónica S.A. and Vodafone Group Plc) plan to create a joint venture to "offer a privacy-led, digital identification solution" (European Commission, 2023b).

Focussing even more on the private sector, one can already observe first applications of digital IDs in place, such as the Star Alliance Biometrics or the Eurostart IProov trial (Lufthansa, 2023; iProov, 2021).

The former example offers biometric facial recognition for star alliance members providing an almost contactless check-in experience through security and boarding without the use of a traditional boarding pass or smartphone. As a registered member on selected airports and operated flights passengers may use this offer exclusively. In order to use the service, users have to download the Lufthansa App, register with a

profile, submit a photograph for the biometric facial recognition, and allow in the notification settings the use of biometrical data. Although, the presented application sounds like a fully functioning process, the provider is suggesting carrying a traditional boarding pass, as there may be situations where it is still required e.g. in border control (Lufthansa, 2023).

The latter offers SmartCheck, a biometric face authentication technology combined with identity documentation scan while using the contactless fast-track services of Eurostar, the high-speed passenger rail service linking the UK with mainland Europe and aims to overcome the beforementioned border entry controls. This trial offers passengers on arrival not to show their passports and electronic tickets physically and hence improving the traveling experience (iProov, 2021).

In a nutshell, good digital ID is unique, authenticated securely via digital channels and more importantly established with people consent, while protecting personal data and allowing to control over its own personal data (White et al., 2019). In contrast to traditional identification documents which bear the risk of loss, theft, or disowned by the authorities or the authorities itself disappeared, a digital ID supports in creating economic benefits through reducing fraud, while increasing transparency and efficiency and finally leading to increased social and economic inclusion. On the contrary, a digital ID also comes with the risk of the “deliberate misuse [...] by government and commercial actors as well as [...] technology failure and security breaches” (White et al., 2019). One solution to overcome the before-mentioned risks associated with a digital ID, are blockchain technologies which may be a suitable solution for more secure and efficient identity management (Zohaib, 2021).

On a final note, combining the role of advanced Artificial Intelligence (AI) augmented with countries’ implications to develop and issue Central Bank Digital Currencies (CBDCs), will most probably further boost the development of a digital ID and will pose in fact an immense influence, both positively and negatively, on our social and economic interactions. Thus, it remains important, both socially and scientifically, to critically accompany these topics in isolation, but also in connection with each other, and to research them in depth, should the opportunity arise.

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