

Do we need central bank digital currencies? Economics, Technology and Institutions

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Conference Report

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Central bank digital currencies (CBDC) have become a vividly discussed topic over the past few years, and the speed of the debate has gained pace recently. To gain an overview of various perspectives on this topic, SUERF and the BAFFI CAREFIN Centre at Bocconi University convened an expert conference. The conference focused on these questions:

- *Is physical or paper cash really vanishing? How far is this process across the world? How big are differences across countries?*
- *What exactly is a CBDC? What are defining properties of a CBDC? What technical options are there? Depending on the combined features, what different types of CBDC might be conceived, and what properties would they each offer?*
- *What are the consequences – pros and cons as well as risks - of the various conceptions of CBDC for society at large (e.g. power balance between state and individual, personal privacy), for citizens and businesses, for the banks (e.g. business model), for central banks (e.g. role, size of balance sheet) and monetary policy (e.g. effectiveness of monetary policy transmission) as well as for financial stability (e.g. bank runs)?*
- *What might be the political economy processes governing the drive towards (or against) the introduction of CBDCs? How might voters', politicians', central banks' and banks' interests and preferences influence this process?*
- *Would an economic system without cash and without a replacement for central bank money, which is available to the general public, be problematic?*
- *Should central banks therefore, if cash were indeed be nearly fully replaced by private payment services, actively offer an electronic alternative issued by the central bank, i.e. a CBDC? Or should central banks actively pursue the transition from paper cash to CBDC? Can central banks decide this themselves? Or is this an issue of such far-reaching consequences, and legal implications, that the democratic instances need to be actively involved?*
- *What are potential risks in the transition and in a potential future CBDC-based system? How about robustness to cyber-crime, electrical outages and extreme crisis situations?*
- *What are first experiences from a pilot project in Uruguay and what is the thinking of pioneering central banks in this field, such as Sveriges Riksbank and the Bank of Canada?*

A first overview

Fabio Panetta, Deputy Governor of the Bank of Italy, in his opening keynote embedded the topic in the wider digital revolution, the fourth industrial revolution, and

the digitization of the financial system, which has been underway for many years (e.g. dematerialization of financial assets, electronic trading platforms, digital and mobile banking etc.). So, why should cash not also become digital? Before developing on this topic further,



Panetta emphasized that CBDC has nothing to do with private crypto assets such as bitcoin. The former would be currency like cash and be governed by the same standards on stability as physical cash, while the latter is not currency but just an asset not backed by any clear governance, mandate, laws or other assets. Concerning the pros and cons of CBDC, Panetta first considered them as a **means of payment**. CBDC would add another digital payment alternative. However, given the already large range of electronic payments options available and the resulting existing strong competition, the marginal value of central banks' additional involvement in an area already well served by the private sector would appear small. However, CBDC might improve access to digital payments to non-banked consumers, a non-negligible fraction of the population even in highly developed countries. Whether this potential advantage would indeed materialize depends on the reasons why these groups are non-banked (cost of banking, remoteness, lack of digital literacy) and needs further research. Finally, CBDC might help save on the high costs associated with physical cash handling, which is estimated to cost at least ½ % of GDP in EU countries. Regarding CBDCs role as store of value, again physical cash involves high storage costs, estimated in the order of 0.5-1% of the value stored, compared to quite negligible storage costs of CBDC. Contrary to bank accounts, CBDC would also be free of credit and liquidity risks. However, this advantage might deprive private banks of a major source of funding, which in the euro area currently makes up 20% of the euro area banking system's funding, with potentially adverse consequences for the cost and supply of bank lending. CBDC might even trigger a "digital bank run". In any event, CBDC would likely push banks' business models towards "narrow banking".

The most important issue is whether it should be **traceable or** to guarantee, as best as possible, **anonymity**, as cash perfectly does. Weighing the pros and cons of the privacy of payments transactions is a choice that does not belong to central banks alone but also to the political sphere, as it affects the heart of personal freedom and modern liberal democracy. This is also linked to the question whether CBDC would be **token-based or account-based**. The former would safeguard privacy better; the latter would imply a huge IT and human resources effort by central banks. Another

important issue is whether CBDC should be **interest-bearing**. This choice would affect the central bank's role, scope of monetary policy action and seigniorage. The monetary transmission mechanism would become more immediate, and, absent physical cash, negative interest rates would become fully feasible. If CBDC were remunerated, it would also become a closer substitute to commercial bank accounts and facilitate digital bank runs. Seigniorage would fall due to the interest paid on CBDC but it would increase through savings on cash handling and increasing demand for central bank liabilities. The overall impact is ambiguous, the distributional impact for society as a whole is non-trivial. An important challenge is also **cyber-security and resilience** to technical failure and **hacking**. Finally, there are a number of **legal issues** to be clarified, such as the legal tender nature of CBDC, whether this would imply that every citizen will need to have the technical means to use it, and whether central banks need authorization by government to issue it.

Weighing the costs against the benefits and considering potential risks, in Panetta's view, the case for CBDC is as yet unclear. The impact and risks of a CBDC on the financial system, the real economy and on society depend on their specific design characteristics. If remunerated and available to anyone at no cost, CBDC would substantially **boost central bank balance sheets**. If account-based, central banks would directly interact with the private non-financial sector. This would substantially increase **central banks' role in the economy. Society, through its democratic instances, should first decide** on its preferences on fundamental matters such as privacy of payments transactions before the central banks comes in with implementing CBDC. Given its well-established nature, its robustness and general acceptance and usability, cash is here to stay, at least for a while.

Is cash really obsolete? Would a CBDC satisfy people's needs as well as cash?

Ruth Judson, Federal Reserve System, offered insights on the **evolution of the demand for banknotes** in the US and in other countries and offered speculations about the effects from CBDC on cash banknote demand. US banknote demand trended down from the 1960s through the mid-1980s and in the years prior to the financial

crisis. The upswing between 1985 and the early-2000s as well as since the financial crisis was driven by large denominations (USD 50 and 100), with smaller denominations trending further down. Much of the upswing was likely the result of foreign demand and coincided with crises. By contrast, US domestic banknote demand has been flat or been falling for all denominations, except for the year 2008, when also domestic demand for large denominations was strong. At a global level, **in almost all countries banknote demand rises, with large denominations dominating** in almost all countries. Relative to GDP, cash demand varies widely across countries; there is no correlation with income levels. In most countries, currency holdings are relatively large and on a stable or rising trend. **Sweden** with very low and rapidly further diminishing cash holdings is an extreme **exception** to the broader global pattern. If a CBDC were introduced alongside paper cash, its voluntary use would depend on who is now using currency and why. Foreign users would probably have no access to CBDC. Regarding **use of large denominations** by US citizens, little is known about **motivations**. They might include precautionary savings for fear of financial instability, privacy concerns, which have always existed but may be increasing in recent years, and gray/black market activities. Very little is known about the relative importance of these three factors, but it is unlikely that users driven by any of them would find a CBDC attractive. Regarding smaller denominations, demand is trending down in the US but very slowly. Circulation in the US is still very high: USD20 notes in circulation are over USD500 per person, USD10 and smaller notes are USD140 per person. It is unclear whether a CBDC would be more appealing than other already existing payments media replacing cash.

CBDC would continue the history of money – various options to design CBDC

Morten Bech, Bank for International Settlements, started by the observation that in the evolution of money, after primitive money, coins and notes, electronic money and digital money, we are now on the verge of creating **digital money 2.0**, the form and characteristics of which are as yet unknown, though. While globally the use of card payments (transactions as share of GDP) has consistently increased over the past decade, so has the amount of cash in circulation as a share of GDP in most

countries. Notable exceptions to the latter trend were Sweden and some EMEs; in the UK, Canada and Australia cash circulation grew only marginally, while card payments grew strongly. Bitcoin as a peer-to-peer version of electronic cash challenged the established centralized model prevalent until then. **Various forms of money can be usefully categorized using four criteria:** wide accessibility, whether they are physical or electronic, whether they are issued by the central bank or privately, and whether they allow peer-to-peer transactions. In this four-dimensional structure, central bank reserves, banknotes, fractional reserve money, bitcoin, Uruguay's e-Peso, central bank retail and wholesale crypto-currencies all fill specific niches and needs. Bech then compared **three forms of CBDC – retail tokens, retail accounts, and wholesale-only tokens** - with existing paper cash and reserves and settlement balances using five criteria. Retail CBDC tokens could fulfil all five criteria, i.e. ensure 24/7 availability, ensure anonymity vis-à-vis the central bank, allow peer-to-peer transfers, bear interest and be capped regarding the size of transactions. CBDC retail accounts could also be available 24/7, anonymity and peer-to-peer transfers would not be possible, while they could also bear interest and be capped. Wholesale-only tokens could be designed to satisfy all five criteria. So, CBDC offers vast degrees of freedom in implementing specific features. Most notably, for monetary policy CBDC would enable the application of **negative interest rates** on CBDC and the issuing of **helicopter money**. Regarding financial stability, CBDC might alter the nature of bank runs and **disrupt banks' business models**.

Alternative CBDC conceptions, four scenarios, and their quite different consequences

Santiago Fernandez de Lis, BBVA Research, defined CBDC as central bank-issued instruments combining cryptography and digital ledger technology to achieve four goals: improved inter-bank settlement, improved payment system efficiency, improved monetary policy effectiveness through overcoming the zero lower bound on nominal interest rates, and stronger surveillance and better financial system stability. He analyzed various **conceivable forms of CBDC by combining three features:** access, anonymity and yield. Contrary to physical cash, access to CBDC might not need to be universal but could also be restricted. Contrary to



physical cash, transactions in CBDC might be identifiable. Contrary to physical cash, CBDC might yield interest.

Combining these three design elements, Fernandez de Lis chose **four scenarios** (more combinations would of course be conceivable) for CBDC to illustrate the **wide range of possible conceptions**.

A. A non-yield-bearing CBDC with restricted access and full identification might be conceived for interbank settlement. In the speaker's view, this would improve wholesale money market efficiency, and the reduction of barriers to entry would open participation of third-party providers.

B. A non-yield bearing CBDC with universal access and anonymity might replace physical cash, at lower cost and with higher efficiency. In the speaker's view, this would improve retail payments efficiency. Having an account with the central bank might need to be made obligatory. As a result, bank deposits and credit might fall. Overall, it would be convenient for end-users. Given anonymity, the informal economy might be encouraged.

C. A yield-bearing CBDC with universal access and anonymity would appear to help central banks overcome the zero lower bound on interest rates. However, this measure amounts to financial repression: thus, negative interest rates might as a further measure prompt the introduction of capital controls to avoid flight to higher yielding assets. Physical cash would also need to be actively abolished by the authorities to make the negative interest rates work. Due to the far-reaching impact of financial repression and the fiscal nature of negative interest rates on CBDC, the frontiers between monetary and fiscal policy would be blurred, raising questions of central bank legitimacy and ultimately threatening central bank independence. Overall, this scenario would therefore be highly disruptive.

D. A non-yield bearing CBDC with universal access and full identification would make the central bank a deposit-taking institution for the general public, increase surveillance and reduce financial system instability. This approach might sharply reduce bank credit unless the central bank redirects funds to the financial systems. This form of CBDC would amount to a total disruption

of banking systems as we know them today, implying a potentially painful transition phase. The lack of bank credit might give rise to new credit mechanisms, e.g. through crowd-funding. The very far-reaching nature of this form of CBDC would again raise issues of central bank legitimacy.

The probability of introduction and the extent of disruption of these four scenarios are plausible to be inversely related. In Fernandez de Lis' assessment, the **less disruptive scenarios A and B** are likely to be introduced **within a five year** horizon. Central banks are aware of the more serious disruption of the financial system in scenarios B to D: they would thus move forward only with gradual testing and implementation. **Increasing competition from private cryptocurrencies might push central banks towards adopting CBDCs.** The **example of first-mover central banks** may increase incentives by other central banks to follow.

EMEs have different needs

Fernandez de Lis concluded with some thoughts on the **special situation in emerging market** economies (EMEs). Using CBDC for interbank settlements (Scenario A) might have merits in EMEs in the event that existing wholesale payment systems are not yet well developed and efficient. An anonymous CBDC cash replacement (Scenario B) might be particularly helpful to enhance financial inclusion and efficiency in EMEs, while risking to consolidate tax evasion. If not credible, such a CBDC could also easily fail, as multiple examples of dollarization have shown. Using CBDC to enhance monetary policy with negative interest rates (Scenario C) is less relevant in EMEs given their usually higher inflation rates. Non-anonymous CBDCs as public deposits at the central bank (Scenario D) would reduce informality but might hamper bancarization in EMEs.

How to design a CBDC, and which consequences would arise?

Andrew T. Levin, Dartmouth College, formulated **broad design principles for CBDC** based on the requirements to provide a legal tender with stable value that facilitates transactions, provides a stable unit of account and serves as a store of value. A **stable unit of**

account is a public good, like metric units etc., which the state should provide. Because of the enabling the use of negative interest rates, CBDC enables the central bank to pursue **true price stability** in the sense of zero average inflation, thus facilitating decisions of households and firms and increasing economic efficiency. CBDC would be **much more cost-efficient** than physical cash. Central banks should implement CBDC not in the form of digital tokens using distributed ledger technology: while these would provide anonymity, they might facilitate criminal activity and are costly and non-instantaneous. Thus, central banks should provide **CBDC through accounts**, using well-established, cheap and fast technology. Rather than providing accounts directly to the public (which might exacerbate bank runs), central banks could provide such **accounts in public-private partnerships through commercial banks** overseen by the central bank. This would enhance privacy and financial system stability. In the spirit of Friedman's rule for optimal monetary policy, **CBDC should yield the same rate of return as other safe assets**. While in the case of physical cash this implies steady-state deflation, digital cash can be interest-bearing, with essentially the same rate of return as short-term government securities, thereby eliminating the costs of holding cash, seigniorage, and thus any conflict between price stability and efficiency. In Levin's view, while **paper currency** should not be abolished it **will become obsolescent**. Given network externalities inherent in payment systems, retailers have strong incentives to curtail the use of paper cash and coins. This in turn will diminish consumers' incentives to carry cash. This feedback loop has proven to be very rapid in Sweden and will become evident elsewhere.

By establishing **graduated fees for transfers between digital and physical cash**, central banks can **eliminate the effective lower bound on interest rates** if the fees are sufficiently substantial for large transactions. This new freedom with regard to interest rate setting would enable to rest on this tool also in severe downturns or crisis and thus to refrain from opaque and discretionary balance sheet tools. Monetary policy would thus become more systematic, transparent and effective. The **central bank's balance sheet** could become quite simple, with assets of short-term government securities matching its digital cash liabilities. Monetary operations would simply adjust the supply of digital cash to meet demand

at the pegged interest rate, with corresponding adjustments in holdings of government securities. As the central bank **no longer generates seigniorage and will cover its costs through minimal transaction fees**, central banks would be better shielded from pressures and political interference. In a crisis, the central bank could fulfill its **lender of last resort role** by providing digital cash to financial institutions in need for assistance.

Central banks should act pro-actively now

To conclude, Levin warned that the **payments system is evolving very rapidly now**. Instability and price level indeterminacy could arise if all payments were made with private currencies. Systemic risks could be exacerbated by the emergence of quasi-monopolistic payments. With the present system, central banks might be unable to mitigate severe deflationary shocks. Thus, **central banks should engage in an active dialogue** with elected officials, the private sector and the general public on whether and how to proceed with launching CBDC.

Is a cash-less society problematic?

Ben Fung, Bank of Canada, defined CBDC as central bank liabilities, widely available to the general public which can be used to make payments. Thus, besides physical cash and electronic central bank reserves, they would represent a **third possible form of central bank ("outside") money**. There are many possible **motivations** for the introduction of CBDC: responding to a decline in the use of physical cash, the preservation of seigniorage and ensuring an adequate share of central bank money in the monetary system; improving the contestability and efficiency of payments; the elimination of the zero lower bound and the facilitation of quantitative easing; improving financial stability; enhancing financial inclusion; and fighting criminal activities.

Fung then focused on two questions: first, **whether a cashless society is problematic**, and how the central bank should respond. The use of cash for payments transactions has been declining in Canada. The rise in the volume of cash circulation is mostly due to high denominations. Nevertheless, cash plays no role in large value payments. The abolition of paper cash would hit those in society that do not have access to bank accounts or electronic payments; but instead of taking this as an



obstacle, one could work on financial and digital inclusion. There is also the question whether the abolition of paper cash would reduce competition in retail payments systems. The loss of seigniorage for central banks due to the abolition of paper cash would be small given the small fraction of cash in central banks' balance sheets. Fung then offered some considerations on the **financial stability implications of a (nearly or completely) paper-cash-less monetary system**. Would the abolition of paper cash reduce the probability of **bank runs** and thus weaken market discipline on banks? In Fung's view not necessarily, since depositors can in any case already now transfer money to other, safer banks or buy government securities, which would remain options for a run also in the absence of paper cash. Furthermore, during episodes of severe financial instability, wholesale runs by large firms were more important than retail runs by small depositors. While periods of financial crises have in the past indeed been associated with a **flight to cash** as a **safe store of value**, they continued to use credit and debit cards. To meet the increased demand for risk-free assets in a systemic banking crisis in a (nearly) cash-less monetary system, the central bank could (a) provide cash from a large emergency stock that it holds for contingencies; (b) rely on government securities as a safe store of value, possibly in smaller denominations in order to widen access to the general public; (c) temporarily open the possibility for savers to open deposits with the central banks (temporary or contingency CBDC).

What would be the consequences of CBDC for payment systems and financial stability?

The second question addressed by Fung was whether the central bank should issue a CBDC to promote the **competition and efficiency in payments systems**, and what the consequences for the financial system would be. First, he sketched the attributes that a CBDC in his view should have: it would be legal tender in national currency convertible to banknotes and reserves at par, it could bear an interest of zero, positive or negative value, it would not involve fees, access would be non-exclusive, it would be available 24/7, supply would be entirely demand-driven, distribution would be channeled through financial institutions, there would be counterparty anonymity, but no anonymity to the financial institution and central bank (to avoid tax

evasion and criminal activity), payments processing would be close to real time, the timing of irrevocability would depend on the technical solution, and the CBDC payment network structure would be distributed and bilateral, not tiered. Such a CBDC would likely reduce paper cash demand but would increase overall central bank seigniorage, there would likely shifts from bank deposits to CBDC, in response banks would raise deposit interest rates, bundle services, rely more on wholesale funding or else reduce lending. Monetary policy would be affected since the central bank would be able to directly influence retail interest rates on CBDC.

Fung concluded that much more in-depth studies are needed to shed light on these and many other issues including potentially high set-up and operating costs, as well as cyber and reputational risks.

What influences the drive towards CBDC: a political economy perspective

Alessandra Cillo and Donato Masciandaro, Bocconi University, reported on an ongoing project which investigates whether people would like CBDC in Italy. They started from the observation of two seemingly contradictory developments: on the one hand, the use of cash has further increased in the euro area over recent years; on the other hand, new private electronic currencies have gained prominence and increasing acceptance. So, there seems to be the need for the safety of assets issued by a state authority, on the one hand, and the technological progress as represented by e.g. private crypto-currencies. Is CBDC, being electronic public legal tender, the answer to this combined need? How high would actual demand for CBDC be? What would the interest elasticity between CBDC and bank deposits be? The presentation then consisted of a theoretical and an empirical part. First, the authors presented a **theoretical model** to identify the **drivers of the political consensus in favor or against a CBDC**. Given three different properties of a currency (two standard functions of medium of exchange and store of value and a third, less explored one of store of information, in other words the risks for privacy from using money for exchanges) and three different types of money (paper currency, banking currency and crypto-currency) and if individuals are rational but at the same time can be subject to behavioral biases (loss aversion), three

different groups of individuals – CBDC lovers, neutrals and haters – emerge. Given the alternative opportunity costs of the different types of currencies, CBDC issuing is more likely to occur, the stronger the preference for a legal tender and/or the more they are indifferent with respect to anonymity. The probability of a CBDC being introduced also increases if it is remunerated and if its implementation can guarantee at least counterparty anonymity. Second, the authors presented a planned **experiment** among 82 Bocconi University students. Subjects will have to choose among 18 types of currencies or payment methods, with **different liquidity risks, expected returns and levels of anonymity**. Using a three-step experimental set-up, the aim is to **find out about individual's relative preferences** attached to the above three properties. This should help to better anticipate public acceptance of various forms of CBDC.

A first CBDC pilot project: considerations, experiences and first results from Uruguay

Jorge Ponce, Central Bank of Uruguay, shared the Bank of Uruguay's experiences with a just finished real world **pilot test** of a digital version of the Uruguayan Peso, called e-Peso. The **e-Peso** was designed as an electronic platform for Uruguayan Peso with legal tender status. To begin with, the legal framework was verified to allow the issuing of electronic bills as a complement to physical ones. Cyber-, information-, financial and reputational risks were reasonably hedged and mitigated. The pilot was performed to test various technical aspects, such as e-Peso production, the digital vault, digital wallets, the transactions system, infrastructure and business continuity. The central bank conducted it in close cooperation with a telecom provider, and a handful of IT and payment solutions providers. The pilot lasted for 6 months from 17 November 2017 until 18 April 2018. A volume of 20 million e-Pesos (equivalent of around EUR 550,000 as at June 2018) was issued. 10,000 mobile phone users, chosen on a first-come-first-serve basis, were involved. E-Pesos were generated at the central bank, transferred from the e-vault to users' digital wallets, and could from there be used for payment transactions in registered stores and businesses as well as for peer-to-peer transfers among registered users. Digital wallets were limited at an equivalent of EUR 800 (EUR 5,500 for registered businesses). Participants were incentivized to initially convert cash into e-Pesos and

then to actively use the system for transactions. At the end of the pilot, e-Pesos were converted back into conventional Pesos, and the e-Pesos were destroyed by the central bank. Currently, the pilot is being evaluated and further steps are being decided. The pilot system provided for instantaneous settlement, relied merely on a working mobile phone line, not requiring an internet connection, the users' wallets and the encrypted e-note manager were designed to render transactions anonymous yet traceable; e-Pesos were secured even if users lost their phones or the password for their digital wallet; unique traceable bills prevented double-spending and falsification.

The overall **experience** with the pilot was **positive**: there were no technical incidents, transactions were mostly peer-to-peer, the number of participating stores and businesses increased over time, and also banks got interested in joining. Overall, Ponce highlighted many **advantages of central bank digital currencies** (lower costs, financial inclusion, prevention of crime and tax evasion, customer protection) and called for central banks to embrace new technologies, which are in any case unavoidable, and be pro-active in promoting further financial innovation in cooperation with the private sector and start-ups.

The Sveriges Riksbank's e-krona project: motivation, state of play, and further plan

Bjorn Segendorf, Sveriges Riksbank, defined a CBDC as a central bank liability, denominated in national currency, available 24/7, more broadly accessible than current central bank deposits. Generally, motivations for issuing a CBDC can be rooted in socio-economic considerations, in financial stability goals, in monetary policy objectives and in the quest for efficiency. In Sweden, retail payments developments are the driver for considering an **e-krona**, as the **use of paper cash is quickly dwindling**. Thus, if cash disappears, the **general public would no longer have access to central bank money**. In the medium term, **Sweden would no longer have a domestic infrastructure for retail payments**, given the dominance of global card schemes, pan-European clearing and the ECB's trend towards multi-currency settlement systems. A retail CBDC would ensure that the Swedish public has access to central bank money. It would provide a payment



infrastructure and may increase payment system resilience. The Riksbank's current concept for an e-krona aims to provide a means of payment primarily between households and firms, it would be accessible 24/7 and process payments in real time. Currently, there is no legal basis for remuneration. The issues of (partial) anonymity and off-line functionality are as yet open.

A CBDC is, however, **no free lunch**. The advantages have to be weighed against the consequences. For instance, in the area of financial stability, many argue that it would enable **instant bank runs** by enabling depositors to shift savings from bank deposits into CBDC and lead to a dramatic expansion of the central bank balance sheet during crises. Segendorf challenged this assertion by showing that the consequences of a bank run on the overall size of the central bank balance sheet need not differ with CBDC as compared to the present situation (while the composition effects differ, of course).

The **e-krona project** is currently underway. Phase 1 in 2017 was devoted to drawing up a general proposal for an e-krona and a potential design for an e-krona system. During phase 2 in 2018 the e-krona concept is refined, deeper legal analyses are being conducted and monetary policy issues are being investigated. By end-2018, the decision to move to stage 3 or to conclude the project will be taken. Phase 3 might either lead to the development and implementation of an e-krona system or be used for a continuation of analyses.

CBDC in the broader context of the current discussion of crypto-currencies

Martin Summer, Oesterreichische Nationalbank, provided an introduction into various forms of money and payments methods, including cash, bank deposits, SEPA, crypto-currencies, emphasizing their distinctive features. Both **paper and book money** crucially rests on trust, be it in the monetary authority or the stability of banks. Trust in the current monetary system relies on a well-established combination of hierarchy between money created by the central bank and deposit institutions, of centralization and coordination with incentives for the parties involved to maintain the integrity of the system. Deposit money is the digital representation of cash, convertible at a fixed rate of 1:1.

Traditional forms of money and payment systems function smoothly and efficiently. Crypto-currencies are privately issued value units convertible to actual currencies at flexible exchange rates. Contrary to the terminology of “digital coins” and “digital wallets”, they are conceptually closer to deposit money and accounts. Agents exchanging crypto-currencies are represented as addresses in computer networks, which do not reveal the owner's identity. Transactions are authorized and verified using cryptographic techniques and the integrity of transactions is verified collectively and in a decentralized manner by “miners”. The latter verify transactions, batch them into blocks and append them to a register of all blocks of verified transactions that ever happened in the network, called the “block-chain”. The popularity of crypto-currencies rest on the fact that a central authority is deliberately excluded, it is open source, and everybody is free to participate. Anonymity adds to its attractiveness. A clever system of technology and economic incentives aims to ensure honest behavior among participants. Given the complex process of creation and encryption, payments in **crypto-currencies** are slower than e.g. SEPA, they have a much lower transaction capacity, and they are inefficiently resource intensive. For these reasons, the use of the block-chain technology would not make sense for CBDC. Even more, the concepts and technology implemented in **crypto-currencies** (in particular the **block-chain** technology) are **irrelevant for** a discussion of CBDC. If CBDC means direct access for citizens to central bank money through accounts at the central banks, this would imply a major structural change in monetary arrangements. Summer doubted, however, why central should go this way: there is **no convincing case** that the still **widespread use of cash** can be interpreted as a **market failure that calls for public policy intervention**.

A macroeconomic perspective: inside versus outside money, and the role of incentives

Dirk Niepelt, University of Bern and CEPR, offered a macroeconomic perspective. Would CBDC be **substituting outside money** (i.e. money coming from outside the private sector, in practice from the central bank) **for inside money** (i.e. money backed by credit from inside the private sector, in practice book money, i.e. deposits at banks which were created through postings in the banks' account books) **change**

macroeconomic outcomes? Does inside money add social value? If not, could we abolish inside money along the lines of the Swiss “Vollgeld initiative”? Niepelt first considered arguments **why substitution might not matter**. As regards money as a store of value, the composition of money between inside and outside money does not affect the economy’s balance sheet; assets, saving and investment are unaffected. By contrast, there also **arguments why substitution does matter**. Incentives to screen borrowers might weaken, the incentive to lend might actually increase. Central banks’ incentives in a politico-economic equilibrium might change. As the monetary system becomes more transparent, support for implicit transfers from the central bank might dwindle. In conclusion, if incentives for central banks and politicians were held constant, “reserves for all” would not change much. However, in reality these **incentives would change**.

The discussion is still at an early stage and many issues are still open and controversial

The conference concluded with an **extended, free, highly explorative discussion** among all conference participants. This discussion highlighted the key controversies around CBDC. It was seriously doubted, and no-one contested, that a CBDC could ultimately guarantee anonymity, even if this were included in its

design. It became obvious that the value attached to privacy of the individual versus state power was maybe THE central distinguishing feature between advocates and adversaries of CBDC. The issue of robustness to cyber-attacks, electric outages and natural catastrophes was highlighted as a weakness, and the solutions offered ranged from ensuring that a CBDC would have to be designed in a way to also operate without the internet, at least for a while, to the recommendation that the central bank should for contingencies always hold a stock of paper cash. Various important legal obstacles were highlighted, including the question whether it would actually be for the central bank or the government itself to issue CBDC.

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The highly focused conference topic as well as the ample room for informal discussion particularly in the last session were highly appreciated by conference participants. This approach ensured that the conference indeed increased all participants’ insight and reflection on the topic. SUERF thanks all speakers and participants for their engagement in this open yet constructive dialogue. SUERF particularly appreciates the long-standing and regular co-operation with the BAFFI CAREFIN Centre at Bocconi University and is grateful for generous sponsoring by Intesa Sanpaolo Bank.

