

CBDCs: Pros and Cons

A comprehensive list and discussion of the advantages and disadvantages of central bank digital currency

Patrick Schueffel

Abstract

Central bank digital currencies (CBDCs) have the potential to fundamentally alter the current monetary system. Potentially they could bring about a whole range of advantages compared to the status quo, yet they could also introduce a host of disadvantages. This text provides a comprehensive list of the pros and cons of CBDC along with a description of every single positive or negative outcome. Finally, it weighs the benefits and drawbacks of this new form of legal tender against each other.

Keywords: CBDC, central bank digital currency, central bank, monetary policy, legal tender, currency

I. INTRODUCTION

Central bank digital currencies (CBDCs) are electronic versions of fiat currencies, issued and backed by central banks [1]. As those legal tenders are solely issued and administered on a digital ledger and no longer exist in the form of notes and coins they are referred to as central bank digital currencies. The consumers will hold this CBDC in a digital wallet, an app that is installed on an electronic device such as a smartphone, tablet or PC. Using the wallet app, the user will then be able to execute transactions and make payments at the physical point of sale or on the Web.

Moreover, CBDC is highly likely to be programmable. Its digital nature will be highly suitable for a digital setting such as the Web and payments will be automatically executed should certain parameters be met. In this way payments and transactions can be automated to the highest possible degree.

With the advancement of technology, the concept of CBDCs has gained traction in recent years, as they have the potential to provide several benefits such as financial inclusion, convenience, and no counterparty risk with commercial banks. However, they also come with certain disadvantages, such as compromised data privacy and regulatory challenges. This text will provide a comprehensive overview of the advantages and disadvantages of CBDCs compared to currently existing monetary system.

II. BACKGROUND

A CBDC is managed by a central bank using a digital ledger. Hence, one single entity, the central bank, has control over the issuance and subsequent administration of this new type of currency. By contrast physical cash is also issued by a central bank, yet the bookkeeping of the currency as well as its management is executed by numerous parties, respectively middlemen, such as banks, businesses, and consumers. Ultimately the bearer of cash is also the custodian of the currency and may or may not keep track of it.

P. Schueffel is adjunct professor at the School of Management Fribourg, HES-SO, 1700 Fribourg, Switzerland (e-mail: patrick.schueffel@hefr.ch).

Received April 12, 2023; revised, July 12, 2023; accepted, July 15, 2023; published: August 8, 2023

The bookkeeping itself can also vary widely, ranging from the meticulous bookkeeping of bank tellers to pocket money being kept in a piggy bank.

Should CBDC be introduced, the currently existing form of money issuance as well as accountancy will undergo a significant qualitative change: the central bank will not only be able to issue or redeem digital central bank money upon a keystroke, but it will also be able to keep track of any transaction conducted subsequently. Any payment from one party to another can be logged on a digital ledger. Should CBDC entirely replace cash, any transaction will be traceable, and any cash could become programmable.

As mentioned, CBDCs will not only lead to a greater degree of centralization and control of legal tender, but also to disintermediation, new data archiving capabilities, and programmability. These characteristics will bring along several advantages. Those are laid out in the following table and described in subsequent sections, first on a societal level, then on an individual level.

Table 1. Pros and Cons of Central Bank Digital Currencies on societal and individual level

	Pros – Advantages of CBDC	Cons – Disadvantages of CBDC
Societal Level	Loss Protection	Compromised Data Privacy
	Convenience	State Surveillance, Decrease in Economic Freedom
	Improved Data Privacy	Crowding out of Commercial Banks
		Destabilization of Financial System
		Depreciative Money & Holding Cap
		Social Credit System
		Hacks
		Attacks of Foreign Malicious Actor
		Poor Acceptance
Individual Level	Financial Inclusion	Spending Caps & Blocks
	Reduction in Crime	Transfer Limits & Blocks
	Less Tax Evasion	FX Limits
	Robustness of Financial System	Capital Export Controls
	Efficient Monetary Policies	Consumption Controls
	Zero Counterparty Risk	Penalty Taxes
	Efficiency	Forced Loans
	Increased Seniorage	Nudge Economics
		Negative Interest
	Geo Fencing & Curfew Enforcement	

III. ADVANTAGES OF CBDC

Financial inclusion, for instance, could be enhanced as this electronically issued legal tender can directly be credited to digital wallets which can be accessed via mobile phones or other digital devices. This may facilitate accessing financial services for individuals and businesses, especially those in remote or underserved areas provided they dispose of a mobile phone and network connectivity. This could make it easier and more convenient for citizens to access financial services and participate in the economy [2]. Moreover, CBDC would also allow for an efficient distribution of universal basic income should governments decide to introduce such subsidies [3].

A **reduction in crime**, especially financial fraud could be another advantage induced by CBDC: Should it become mandatory that digital wallets be linked to a person's national identification, allowing for easy verification of identity, financial fraud could be reduced substantially as all transactions would be traceable and thus adhere to higher AML and KYC standards as current cash [4]. Besides, physical cash, especially notes is prone to counterfeiting. Being digital and directly issued by the central CBDC would not be vulnerable to the conventional means of counterfeiting [5].

Moreover, if the CBDC design satisfies the public policy requirements of other supervisory and tax regimes, it is safe to say that a CBDC regime has the potential to induce a significant **reduction of tax evasion** as it would be the only legal tender in a scenario where CBDC has replaced physical notes and coins [6]. Moreover, the programmability of CBDC would allow entirely new and highly efficient methods of tax collection [7]. Virtually any tax could be charged at source, from VAT to income tax. Even import and export duties could be

collected at source.

CBDCs are issued by central banks. This fact eliminates the risk of default or counterparty risk that exists in traditional banking systems. Transactions with CBDCs would be settled directly with the central bank. The user can therefore rest assured that he or she will always get paid the balance that they are due, and any transaction would thus bear zero **counterparty risk** with commercial banks [8].

Arguably this reduction of counterparty risk would also increase of the security and stability of the financial system and thus enhance the **robustness of the financial system** as it would scale down the role of banks in money creation and thus moral hazard [9].

Furthermore, it is argued that the CBDC would further contribute to the stability of the financial system as it provides more possibilities to implement **efficient monetary policies** not least because central banks can bypass intermediaries and directly target sectors or groups [10]. For instance, helicopter money could be distributed in a highly efficient manner [9], but governments could also take advantage of CBDCs' programmability to manipulate the value of the currency which could be used to manage economic instability, stimulate economic growth, or support certain industries [11]. Most notably, however, central bankers suggest that it is easier to implement negative interest rates on cash holdings under a CBDC regime and thus reduce the money in circulation [12].

In general, it is also argued that CBDCs would boost the **efficiency** of payment systems altogether as CBDCs would lower not only settlement costs, but also reduce frictions and fees associated with payments as fewer middlemen are involved and thus risks reduced [13]. A consumer could for instance pay at the point of sale and the vendor would immediately receive the funds without delay and free of risk.

Since banks would be disintermediated their role in the monetary system in general and for money creation in particular would be significantly reduced. As a result, commercial banks would create less money and central banks would increase their money creation. Consequently, government, respectively the public would benefit from collecting **increased seigniorage** instead of a range of privately owned commercial banks [9].

On an individual level then following advantages can be identified for the consumer: As all accounts and their balances are logged centrally, CBDC will also safeguard users from the loss of money. Should a device on which CBDCs are stored get lost or corrupted, the bookkeeping at the central bank will serve as a **loss protection**. A consumer could therefore no longer "lose" cash. [14, 15].

Another argument in favor of CBDC is **convenience**: CBDCs could potentially facilitate the development of new financial products and services, such as peer-to-peer transactions, digital payments, and micro-lending as it offers possibilities to aggregate balances in a fashion that do not exist for cash and traditional bank accounts [16].

Improved data privacy is oftentimes given as another argument for the introduction of retail CBDC: when a monetary transaction is made among contracting parties, banks or payment providers can gather information on the deal itself and on the buyer and seller. Gathered at large scale this information is extremely valuable and at times sold on to interested parties without the user profiting the sales of his or her data. CBDC would put an end to rent generation as central banks would not engage in such data gathering and sales thereof [17]. The end-user would no longer give away valuable information to private entities for free and run the risk that they are traded on.

IV. DISADVANTAGES OF CBDC

A higher degree of centralization and an elevated control of the legal tender in circulation along with disintermediation, new transaction logging abilities, and programmability can theoretically yield the above-mentioned advantages of CBDC vis-à-vis current cash and electronic money. Yet, there is a flip side to this story: just as these characteristics can be used to the benefit of consumers, they can be used to handicap the citizen or society as a whole. Undoubtedly some of these actions can also be taken under the current monetary regime. But CBDCs will facilitate matters: going forward these measures can be implemented on a keystroke, in real-time and centrally. No more lengthy data gathering, and alignment of parties will be required. Starting on societal level before going down to the consumer level, the disadvantages are the following ones:

CBDCs could enable governments to access citizens' transaction data, which could be used to track and monitor their financial transactions, potentially violating their privacy and economic freedom. This data could also be shared with other government agencies or private entities, leading to ever higher degree **compromised data privacy** of citizens [18].

Resulting from the compromised data privacy governments could gain more control over citizens' financial transactions, which could lead to an increase in **state surveillance and a decrease in economic freedom**. Governments could use their newly gained powers by excusing them with the need to control of inflation, manage economic instability, or support certain industries [19].

Given that the CBDC balance is directly held with the central bank, the introduction of retail CBDC could lead to a decrease in the volume of traditional bank deposits, which could lead to a decline in the profitability and stability of commercial banks. This **crowding out of commercial banks** by the central bank may lead to a concentration of financial power in the hands of the central bank and a decrease in competition in the banking sector [20].

What is more, the large-scale adoption of CBDCs and thus a wide-spread flight to the safe harbor central bank could ultimately lead to a **destabilization of the financial system**, which in turn could lead to a financial crisis should a bank run occur [21].

As mentioned afore the programmability of CBDC will provide central banks with a wider range of possibilities to efficiently implement monetary policies. One of these tools could be **depreciative money**. On a macro-level this could be a highly efficient tool to increase the effects of governmental stimulus or boost economic activity in general. By putting a best-before label on money consumers could be forced to spend their money before it becomes worthless [11]. The citizen clearly runs the risk that his or her money is rendered worthless, if not spent in time. A similar effect could be generated by imposing a **holding cap** [22]: citizens could be restricted to holding a certain amount of money in order to foster consumption. Any amount above that saving cap could become worthless.

Once retail CBDC has been replaced physical cash, it could be linked to a digital ID in order to enable governments to implement a **social credit system**. Such as social credit system could track and monitor citizens' financial and social and ethical behavior. This will undoubtedly not only lead to a decrease in an individual's privacy and autonomy but could also be used to control certain behaviors such as travels and purchases and restrict certain rights such as the freedom of movement or contractual freedom [23].

Being not only digital in nature but also instantly settled, CBDCs will in all likelihood call for **hacks** against the CBDC system [24]. A successful hack could result in electronic counterfeiting of money, the theft of funds, or even to a disruption of the financial system and ultimately loss of confidence in the currency. Additionally, hackers could even use CBDCs to evade sanctions or launder money [25].

Should foreign governments become party to such hacks, they could also be brought to an entirely new level and result in deliberate **attacks of malicious foreign actors**. Parties located abroad could attempt to hack the ledgers of central banks in order to obtain the payment information stored in such ledgers. This could be used for espionage purposes. Moreover, well-funded nationstate attackers could strive to identify weaknesses of the system in order to illegally obtain foreign exchange, potentially also undermining AML and KYC rules. Ultimately, however, hostile foreign actors could attack the CBDC system of a country to disrupt the financial system and thus the economy and ultimately destabilize the entire country.

Given the disadvantages mentioned afore it may not come as a surprise should counterparties be reluctant to accept CBDC. The restrictions that can be potentially incorporated in CBDC by utilizing their programmability may result in a **poor acceptance** of digital legal tender. This may be all the more the case in cross-border settings, such as international trade, where the receiving party may not trust the central bank of the paying party [26]. The value of a currency, however, large stems from it being widely accepted [27].

Since CBDC are digital currencies, transacted instantaneously over a network and stored in electronic wallets they will typically rely on the availability of energy and web connectivity [28]. Thus, their **electricity and network dependence** is not to be underestimated. Outages or disruptions in these services may lead to a loss of access to funds and could potentially even disrupt the financial system. This could be especially problematic in underdeveloped or remote areas with limited access to electricity and internet connectivity.

As the disadvantages of CBDC were laid out on societal level, the following paragraphs will describe how CBDC may negatively affect individuals.

Governments could use CBDCs to impose spending caps on certain individuals or groups of citizens, which could limit their financial freedom and ability to transact. A case in point are **spending caps**: the consumer could be restricted in the amount of money he or she can spend. This could be used to steer specific industry sectors but also to impose sanctions on specific groups of people, for instance to prevent people receiving welfare payments for groceries to spend these subsidies on anything but food. The most extreme case of the spending cap is the **spending block**: here the administration could use CBDCs to freeze or block the accounts of individuals or organizations that are deemed to be engaging in suspicious or illegal activities,

thereby restricting their financial resources and ability to transact. In this way the funds of oppositional protesters, for instance could be rendered useless as they cannot spend them any longer and are thus forced to cease their campaign [29].

In a similar vein **transfer limits** could be utilized by governments to impose limits on the amount of money that can be transferred among individuals and entities [5]. If, for example, a government imposes a limit on party donations it could introduce such transfer limits to enforce such a rule. Similar to the spending block a **transfer block** is the most extreme case of a transfer limit as it sets the payment limit to zero. Such radical measures could be applied by government to block certain types of transfers, such as those to or from certain individuals or organizations which are deemed suspicious or illegal by the administration. Oppositional parties, for instance, could no longer receive any monetary support.

CBDCs could also be applied by governments to control capital flight, manage balance of payments, or preserve exchange rate stability. For the individual consumer this could result in tangible **foreign exchange limits**: he could become restricted in the amounts of currency that can be converted into foreign currency [9]. Should a citizen of a high-inflation country, for instance, decide to convert parts of her life savings into a foreign currency, her government could prevent her from doing so. Conversely governments could also confiscate funds held by foreigners in CBDC should they deem it appropriate. Tensions or conflicts with foreign nations may justify such a step.

Just as well as foreign exchange limits government could impose **capital export controls** [30]. The motivation to do so could be similar: trade sanctions, fostering domestic growth and protecting national security but also managing balance of payments and preserving exchange rate stability. What it means for the citizen, however, is that she would be limited in the amount of money she could bring abroad. Retiring with the life savings abroad could be made impossible from one day to another and so could be purchasing real assets in a foreign country to protect oneself from domestic inflation.

The deployment of CBDCs will potentially provide government with a vast database containing any transaction that any individual or legal entity has ever made. Besides, its programmability will give the administration the possibility to impose restrictions on what citizens can buy or consume, for example through a carbon budget [31]. Such **consumption controls** could be applied to specific industries, goods and service, but also down to the individual level, such as preventing an individual to buy a plane ticket in case of a low carbon budget.

Another approach for steering the consumption is to impose **penalty taxes**. These could be levied on certain types of transactions or activities in order to discourage certain behavior or discourage the use of certain financial products or services. Designed accordingly, CBDC could, for instance, be used to steer the consumption towards ESG compliant goods and services and away from so called “sin goods”, such as alcohol and tobacco, candies, drugs, soft drinks, fast foods, coffee, sugar, gambling etc. [32].

Throughout centuries the concept of **forced loans** has been applied by rulers and governments at times. Such compulsory loans are loans to the government that individuals are required to make in fiscal emergencies. Thus, the citizen is forced to lend money to the government which has the economic effect of a compulsory levy or tax. Given the programmability and the potential usage of smart contracts [25], forced loans could be imposed on the consumer with the introduction of CBDC.

Nudge economics is a term to describe the possibility to manipulate an individual's choice and to lead him or her to make specific decisions. CBDC could be used by governments to influence their citizens to make certain choices [33], such as to nudge consumers towards products and services they deem healthy, green or pro-social or towards business and organizations which are ESG compliant.

Thus far consumers regularly increase their savings quota during crises to build up a buffer against economic hardships. As this behavior oftentimes thwarts governmental efforts to stimulate the economy, central banks could impose **negative interest on cash holdings** [12]. By doing so the individual is pushed to spend his savings as otherwise those reserves will continuously lose in value. The safekeeping function of traditional cash “under the mattress” would no longer be available as the central bank is the custodian of this new money and not the saver.

Geo-fencing refers to the ability to set geographic boundaries and limit the usage of a particular products or services to those confines. It is commonly used in mobile apps and digital advertising. The programmability of CBDCs could potentially enable the implementation of various restrictions and rules, including geographical limitations [22]. Governments could use this functionality to manage public health crisis such as the outbreak of a virus. In a more extreme version geo-fencing combined with predefined timings could be used for curfew enforcement. Notwithstanding this measure would restrict citizens' freedom of movement,

potentially violating their human rights. It could also be abused to limit protests and hamper the movement of political opponents.

V. DISCUSSION

As was shown a monetary system based on CBDCs has various advantages vis-a-vis the status quo. Yet, it also bears also many disadvantages. When weighing these pros and cons against each other it becomes apparent that a choice emerges between security, stability, equality, efficiency and convenience on the one hand versus surveillance, control and centralization on the other. The question that arises is essentially how many of the latter elements the sovereign citizen is willing to accept in order to reap the benefits of the former ones.

Should the central bank become the counterparty against which all transactions are settled going forward, and commercial banks disintermediated, the question arises which role commercial banks would play altogether. Further entertaining this train of thought, the question arises which purpose capital markets would have in the future as any means of payment that circumvent CBDC could also be banned under a tight CBDC regime, including the transfer of securities. As any monetary transaction would then be subject to approval of the central bank, and the value of such transaction could also be set by the central bank, free markets would no longer exist. Under these conditions the economy would effectively turn into a centrally planned economy.

But the economy is not the only field of concern. Among others, democracy rests on the principles of free and fair elections, the protection of human rights, and citizen participation. While it is not claimed that CBDC will necessarily undermine these principles, it has the potential to be a highly efficient tool to do exactly that:

CBDCs could hamper free and fair elections by enabling the governing administration to monitor and control the flow of money, which could be used to influence elections. For example, a government could use CBDCs to track the spending of political parties or individual candidates, and potentially limit their ability to spend money on their campaigns. CBDCs could also be used to impose transfer limits and blocks, which could restrict citizens' ability to financially support organizations or movements that promote freedom of speech. For example, governments could use CBDCs to block cross-border transactions to foreign organizations that promote freedom of speech and democracy. This could undermine the fairness of elections by limiting the ability of candidates to compete on an equal footing.

CBDCs could furthermore negatively impact human rights if they are used to restrict or monitor the activities of individuals or organizations. For instance, should transactions with CBDC be subject to surveillance or censorship, it could limit the freedom of speech, expression and movement of individuals who use them as this information could be used to track and monitor citizens' behavior, including their political activities and associations. What is more, if CBDCs are not designed to protect the privacy of individuals, this could expose them to surveillance and tracking, if not blackmailing by governments or other organizations.

Citizen participation is also at stake should CBDC not be equally accessible to all citizens. If CBDCs are only available to certain groups of people due to censorship or require access to technology that not everyone has, it could limit the ability of citizens to participate in the economy and influence the democratic process. Besides, if CBDC transactions are subject to surveillance providing governments with detailed information about citizens' financial transactions, including who they are sending money to and what they are buying, it could curb the willingness and ability of citizens to engage in free and open communication and participate in civic activities.

VI. CONCLUSION

CBDCs do have the potential to provide substantial benefits such as financial inclusion, a reduced crime rate, more efficiency and convenience. Yet, this comes with a substantial price tag, that is compromised data privacy of citizens and ever greater centralization of powers with the government. What is ultimately at stake for western countries is not only the free-market economy but democracy itself. Simply hoping that nothing will go wrong once a such powerful tool such as CBDC is given to ones is in power, will not suffice. History is full of examples where innovative processes and technologies were eventually used by governments against their own people.

REFERENCES

- [1] D. Salampasis, P. Schueffel, R. Dominic, and D. Cameron, "Central Bank Digital Currencies: Opening Pandora's Box or Paving the Future of Money?". *The Emerald Handbook on Cryptoassets: Investment Opportunities and Challenges*, vol.: p. 283-306, 2023.
- [2] R.A. Auer, H. Banka, N.Y. Boakye-Adjei, A. Faragallah, J. Frost, H. Natarajan, and J. Prenio, "Central bank digital currencies: a new tool in the financial inclusion toolkit?". Bank for International Settlements, Financial Stability Institute, 2022.
- [3] K.S. Söilen, "The internet is leading the world towards forms of totalitarianism: How to fix the problem". *Journal of Intelligence Studies in Business*, vol. 11, no. 1, 2021.
- [4] W. Engert and B.S.-C. Fung, "Central bank digital currency: Motivations and implications", Bank of Canada Staff Discussion Paper, 2017.
- [5] K. Löber and A. Houben, "Central bank digital currencies", Committee on Payments and Market Infrastructures Markets Committee, Editor Markets Committee: Basel, Switzerland, 2018.
- [6] O. Kwon, S. Lee, and J. Park, "Central bank digital currency, tax evasion, and inflation tax". *Economic Inquiry*, vol. 60, no. 4: p. 1497-1519, 2022.
- [7] D. Mitra, "Glimpses on digital currency - A case study of China", in *An Approach Towards Central Bank Digital Currency*, E. LauPoh Hock, Editor, Kunal Books: New Delhi. p. 228, 2022.
- [8] E. Prasad, "The case for central bank digital currencies". *Cato J.*, vol. 41: p. 251, 2021.
- [9] U. Bindseil, "Central bank digital currency: Financial system implications and control". *International Journal of Political Economy*, vol. 48, no. 4: p. 303-335, 2019.
- [10] Oxford Analytica, "Digital currencies hold much promise for central banks". *Emerald Expert Briefings*, vol. no. oxan-db, 2020.
- [11] F. Tata, "Proposing an interval design feature to Central Bank Digital Currencies". *Research in International Business and Finance*, vol. 64: p. 101898, 2023.
- [12] M. Davoodalhosseini, F. Rivadeneyra, and Y. Zhu, "CBDC and monetary policy", Bank of Canada: Ottawa, 2020.
- [13] A. Baronchelli, H. Halaburda, and A. Teytelboym, "Central bank digital currencies risk becoming a digital Leviathan". *Nature Human Behaviour*, vol. 6, no. 7: p. 907-909, 2022.
- [14] K.J. Choi, R. Henry, A. Lehar, J. Reardon, and R. Safavi-Naini, "A Proposal for a Canadian CBDC", 2021.
- [15] C.M. Kahn, M.R. Van Oordt, and Y. Zhu, "Best before? Expiring central bank digital currency and loss recovery", Bank of Canada Staff Working Paper, 2021.
- [16] C.M. Kahn and F. Rivadeneyra, "Security and convenience of a central bank digital currency", Bank of Canada, 2020.
- [17] T. Ahnert, P. Hoffmann, and C. Monet, "The digital economy, privacy, and CBDC". vol., 2022.
- [18] B. Coeuré, J. Cunliffe, T. Lane, F. Panetta, S. Uchida, C. Skingsley, F. Zurbrügg, L. Brainard, and H.S. Shin, "Central bank digital currencies: foundational principles and core features", Report, 2020.
- [19] European Central Bank, "Virtual currency schemes – a further analysis", ECB, Editor: Frankfurt, 2015.
- [20] W. Bian, Y. Ji, and P. Wang, "The crowding-out effect of central bank digital currencies: A simple and generalizable payment portfolio model". *Finance Research Letters*, vol. 43: p. 102010, 2021.
- [21] E. Monnet, A. Riva, and S. Ungaro, "The Real Effects of Bank Runs. Evidence from the French Great Depression (1930-1931)". vol., 2021.
- [22] BIS, "CBDCs: an opportunity for the monetary system", in *Annual Economic Report*, Bank for International Settlements: Basel. p. 65-95, 2021.
- [23] Y.J. Fanusie and E. Jin, "China's digital currency". *Retrieved May*, vol. 4: p. 2022, 2021.
- [24] S. Allen, S. Čapkun, I. Eyal, G. Fanti, B.A. Ford, J. Grimmelmann, A. Juels, K. Kostianen, S. Meiklejohn, and A. Miller, "Design choices for central bank digital currency: Policy and technical considerations", National Bureau of Economic Research, 2020.
- [25] Bank of England, "Central Bank Digital Currency - Opportunities, challenges and design": London, 2020.
- [26] J. Slawotsky, "US financial hegemony: the digital yuan and risks of dollar de-weaponization". *Fordham Int'l LJ*, vol. 44: p. 39, 2020.
- [27] A. Pareek and A. Manur, "De-Dollarising Nexus: A Mirage", Takshashila Institution, 2022.
- [28] T. Mancini-Griffoli, M.S.M. Peria, I. Agur, A. Ari, J. Kiff, A. Popescu, and C. Rochon, "Casting light on central bank digital currency". *IMF staff discussion note*, vol. 8, no. 18: p. 1-39, 2018.

- [29] J. Slawotsky, "Digital currencies and great power rivalry: China as a disseminator in the digital age". *Asia Pacific Law Review*, vol. 30, no. 2: p. 242-264, 2022.
- [30] K. Foster, S. Blakstad, S. Gazi, and M. Bos, "Digital currencies and CBDC impacts on least developed countries (LDCs)". *The Dialogue on Global Digital Finance Governance Paper Series*, vol., 2021.
- [31] D.B. Chen, J. van der Beek, and J. Cloud, "Hypothesis for a Risk Cost of Carbon: Revising the Externalities and Ethics of Climate Change". *Understanding Risks and Uncertainties in Energy and Climate Policy: Multidisciplinary Methods and Tools for a Low Carbon Society*, vol.: p. 183-222, 2019.
- [32] I. Agur, A. Ari, and G. Dell’Ariccia, "Designing central bank digital currencies". *Journal of Monetary Economics*, vol. 125: p. 62-79, 2022.
- [33] M. Dapp, "From Fiat to Crypto: The Present and Future of Money". *Finance 4.0-Towards a Socio-Ecological Finance System: A Participatory Framework to Promote Sustainability*, vol.: p. 1-25, 2021.

Patrick Schueffel holds a doctorate degree in business administration from the University of Reading, UK and further postgraduate degrees in business administration from Henley Business School, UK, the Norwegian School of Economics, Norway, and the University of Mannheim, Germany. Currently he is an adjunct professor at the School of Management Fribourg, Switzerland.