



Prospects and challenges of introducing a central bank digital currency

During the last decade, an increasing number of central banks launched research and carried out several pilot programs on developing and introducing a central bank digital currency (CBDC),¹ a digital payment instrument, which is a direct liability of the central bank. To a large extent, CBDC will replicate the functions of paper money – such as store of value, unit of account, and medium of exchange, and have the same basic characteristics as durability, portability, divisibility, uniformity, limited supply and acceptability.² Those activities and associated policy dilemmas and challenges are becoming particularly important in the current environment of transitioning from, one, ultra-loose, monetary policy framework that prevailed in the advanced economies for many years, to another, associated with rising interest rates and shrinking central bank balance sheets.

Currently 105 countries, representing over 95 per cent of global GDP, are exploring the possibility of launching a CBDC,³ up from only 35 countries in May 2020. This research takes place against the background of rapid advances in the digitalization of economies and especially of financial services. The central banks have also been paying close attention to the rapid expansion in cryptocurrencies, such as Bitcoin and Ethereum, that are acting both as means of payment, somewhat challenging the role of traditional money, and also as financial assets. However, these cryptocurrencies have repeatedly exhibited episodes of high volatility, which prompted the development of the so-called stablecoins that are expected to maintain fixed value versus traditional currencies using back-up monetary reserves. The central banks, trying to assess the impact of these new digital monetary instruments on conventional monetary policy and overall financial stability, expressed concerns with respect to those developments. They perceived the proliferation of cryptocurrencies as a path to the possible fragmentation of the existing monetary system, and repeatedly warned about potential risks to financial stability emanating from the volatility of cryptocurrencies. The increased risk of money laundering using this newly emerging payment instrument was another area of concern for monetary authorities and governments.

KEY MESSAGES

- » Central banks across the globe are conducting extensive research and implementing pilot programs with respect to central bank digital currencies (CBDCs).
- » Introducing CBDCs for widespread use may have positive effects for the economy but also present new challenges, as its impact on financial intermediation and fiscal and monetary policy operations are not yet fully understood.
- » Extensive, well-informed public discussions with all relevant stakeholders are necessary, as the designs of CBDCs are finalised, including discussions on the environmental footprint of digital currency projects.

To keep pace with the ongoing digitalization of financial services and to address the above-mentioned challenges, central banks, along with governments, have advocated for the introduction of new regulations for cryptocurrencies and other forms of independently issued crypto assets.⁴ Central banks have also started research on the feasibility of issuing their own digital currency or CBDC. In principle, some forms of CBDCs have already existed in a two-tier banking system, where the central bank interacts with a network of commercial banks.⁵ Most of the commercial bank's transactions with a central bank are conducted electronically and existing “wholesale” payment systems can be considered as a form of digital money. For example, the European Central Bank's TARGET-2 digital payment system processes payments with a total value of close to 20 per cent of the euro area GDP every day. In the United States, most of the reserves kept by commercial banks at the Federal Reserve Banks and used for interbank settlements are also in digital form.

The proposed models of CBDC, however, are expected to also contain a retail component which will constitute the central bank's liability and will be accessible to private individuals and

¹ See, for example, Codruta Boar and Andreas Wehrli (2021), *Ready, steady, go? – Results of the third BIS survey on central bank digital currency*, BIS Papers No. 114, January.

² Federal Reserve Bank of St. Louis, *Functions of Money - The Economic Lowdown Podcast Series*.

³ Atlantic Council, *Central bank digital tracker*.

⁴ For example, the EU Regulation on Markets in Crypto-Assets (MiCA) and on the current legislative proposals on anti-money laundering and countering the financing of terrorism, especially in relation to information accompanying transfers of funds and certain crypto-assets (FCTR).

⁵ The functions of central bank and commercial banks in the two-tier system are clearly defined – while the central bank is the highest monetary authority in the country and the ultimate source of money supply, enjoying the monopoly of note issue, devises monetary policy, acts as a lender of last resort for commercial banks, and has a supervisory function, commercial banks act for profit, accepting deposits from population and businesses and engaging in retail and investment lending.

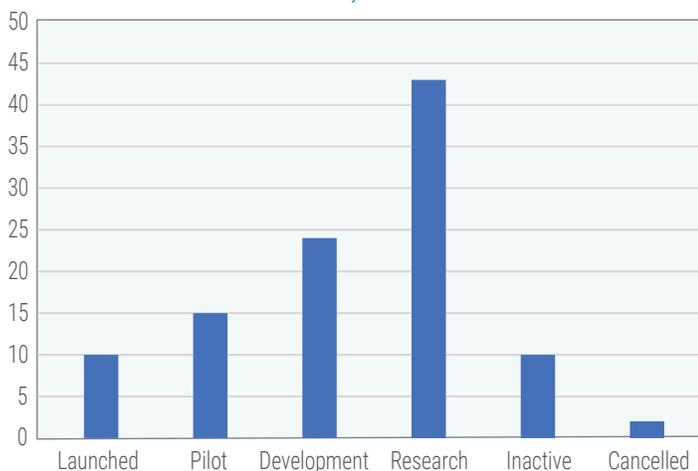
non-financial private businesses and may be based on a distributed ledger technology such as blockchain.⁶

The progress with respect to the research and implementation of the CBDC so far has been uneven (figure 1).

Figure 1

Status on the CBDC progress as of June 2022

Number of countries out of 109 surveyed



Source: The Atlantic Council, Central bank digital tracker.

Note: Among the 10 countries that have already launched CBDC, 7 countries in the Caribbean launched it as a cross-border project of the Eastern Caribbean Central Bank.

Among the leading central banks, the European Central Bank (ECB) officially launched a digital currency project in 2021, aiming to move to the development stage as early as 2023. It is nevertheless expected to take three more years before private citizens may hold European CBDC. The ECB is exploring the possibility of a digital euro ledger and ensuring access to digital currency for people without internet connection.

In January 2022, the Federal Reserve, through its Board of Governors released a white paper that discusses the potential benefits and risks of introducing CBDC.⁷ The responses of banking and finance industry bodies, including the American Bankers Association (ABA), Bank Policy Institute (BPI), and the Institute of International Finance (IIF) have not been supportive at this stage,⁸ expressing concerns that a CBDC will reduce deposit base within the banking system, impose additional costs on financial intermediaries, such as anti-money laundering efforts, without receiving proper compensation, and would hardly improve cross-border transactions.

In China, a prototype of CBDC is already available in several provinces through digital wallets, and a possibility of cross-border use of electronic renminbi is being researched together with the Hong Kong Monetary Authority.

There are also several projects that are seeking to create CBDC arrangements including cross-border transactions (for

⁶ Digital systems, such as blockchain, where information is stored, accessed and updated using cryptography across a network of nodes.

⁷ Board of Governors of the Federal Reserve System (2022), *Money and Payments: The U.S. Dollar in the Age of Digital Transformation*, January.

⁸ Ledger Insights (2022), *Financial institutions respond to Federal Reserve CBDC paper*, May.

example, the mBridge project,⁹ covering China, Hong Kong, Special Administrative Region of China, Thailand and the United Arab Emirates), most of them targeting wholesale payments.

Meanwhile, a number of smaller economies have already moved ahead with the implementation of CBDC. In October 2020, the Central Bank of the Bahamas issued the Sand Dollar, a retail CBDC accessible in mobile applications. The Eastern Caribbean Central Bank (ECCB) launched a digital currency called DCash in March 2021. In both cases, digital currency can be issued and distributed by licensed financial organizations and serves as financial transactions between individuals and also between customers and businesses.

Benefits and drawbacks of CBDC

A CBDC is expected to improve the functioning of the existing payment system and financial supervision, in particular, by minimizing the risks of counterfeiting and reducing the number of monetary transactions conducted by commercial banks and private businesses, curtailing tax evasion, and cracking down on shadow banking and money laundering. Introduction of a CBDC is also expected to improve the precision of regulating money supply,¹⁰ improve monetary policy transmission channels, and make monetary policy transparent in general. In developing countries, CBDC can be a useful tool to modernize the existing payments system via digitalization. In many of those developing countries, the financial sector is underdeveloped and a large share of the economy is cash-based with most of the population having no access to various banking services outside of mobile phone-based services of money transfers, payments and micro-financing (figure 2). The introduction of CBDCs would at least enhance access to payments services, for example, via mobile phones and digital wallets, for those that do not have bank accounts, and introduce competition in the domestic payments market reducing the cost of transactions.

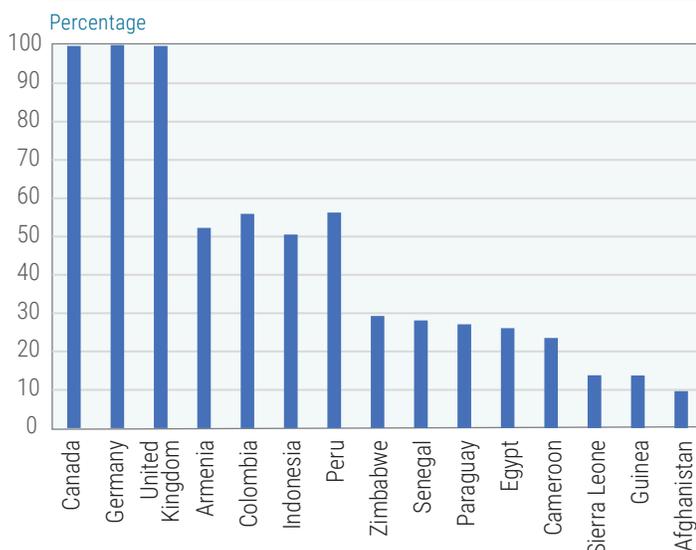
There are also certain risks associated with the introduction of CBDC. In particular, the impact of CBDC on financial intermediation is not fully understood. Widespread use of CBDC may, for example, undermine existing banking systems by increasing the number of payments bypassing commercial banks, affecting deposit creation, and eventually, curbing credit availability and raising lending costs. These risks may be especially pronounced in the case of the so-called one-tier CBDC model, where private individuals are expected to hold digital currency accounts directly with the central bank. In such a model, with the expansion of CBDC holdings by population and businesses, central banks may be tempted to provide credit allocation directly or set the retail lending rate, crowding out the banking sector and distorting competition. Since cash transactions conducted with CBDCs are not anonymous in most of the designed models, certain challenges to individual privacy may emerge. Government monitoring, cyber-attacks and privacy breaches into the CBDC network are also major concerns.

⁹ mBridge: Building a multi CBDC platform for international payments.

¹⁰ J. D. Agarwal, Manju Agarwal, Aman Agarwal and Yamini Agarwal (2021), *Economics of cryptocurrencies: Artificial intelligence, blockchain, and digital currency*, in *Information for Efficient Decision Making: Big Data, Blockchain and Relevance*, Kashi R Balachandran, ed. World Scientific.

Figure 2

Share of population over 15 years of age with accounts at financial institution in 2021



Source: The World Bank.

An increasing demand for CBDC, if it is not matched by declining demand for paper cash, would tempt central banks to expand their balance sheets by acquiring lower quality and less liquid assets, driving up prices of such assets and introducing market distortions, such as asset price bubbles and credit misallocation.

Other risks are related to advancing of cross-border payments using CBDCs, that may lead to currency substitution in those small developing countries that are not able to adopt their own CBDCs¹¹ and cause capital flow volatility, unless the large issuers of CBDC put in place strong regulatory and verification mechanisms. Development of cross-border CBDC projects by large number of countries, or even or smaller number of large countries may also lead to a fragmented international payments system, which may adversely affect trade finance and consequently international trade flows.

Choosing between different CBDC models

Finding an optimal design for CBDC is a challenging task since central banks are simultaneously facing several, and sometimes competing, objectives. From the technological point of view, a choice must be made between a distributed ledger technology and a centralized database model, with each having their pros and cons. Central banks will also choose between the conventional two-tier system of central bank interacting with commercial banks, where retail customers would have digital currency accounts (if an account-based model of CBDC is chosen) and a one-tier system, where digital currency accounts of private individuals and businesses are held directly with the central bank.

Central banks will also need to choose between retail CBDCs based on individual accounts and digital token-based schemes of digital currency. Individual accounts would be more efficient in

preventing illicit financial activities, such as money laundering and funding of terrorism, and may offer better protection of the funds, but would come at the cost of anonymity. Digital tokens on the other hand, can provide a much higher degree of anonymity but would offer much lower levels of deposit security, and would have costs (for example, in case of forgetting the password to a digital wallet, access to the funds may be problematic). A digital token model would also have a higher carbon footprint.

One of the other key questions is whether a CBDC should be interest-bearing. Different options are being considered, including suggestions that digital currencies issued by central banks should be indexed to the country's inflation rate.¹² In a one-tier system, the interest rate on CBDC may become a primary monetary policy tool for a central bank, reducing the need for unconventional policies and quantitative easing for addressing large and unexpected shocks to aggregate demand. There are however concerns that the introduction of interest-bearing CBDCs in a one-tier system would decrease the supply of funds to commercial banks, impeding credit creation and leading to higher nominal interest rate and lower commercial bank reserves. It may also pose risks for financial stability in case of panic and a run on banks. To prevent this, it might be desirable for CBDC to offer an interest rate below the central bank policy rate.

On the other hand, it is also argued that an interest-bearing CBDC would enhance banking sector competition by raising deposit rates, attracting funds and improving financial intermediation. In a model where CBDC completely replaces cash, in case of a one-tier system, the central bank may even introduce a negative interest rate on CBDC accounts during episodes of persistent deflation, overcoming the zero-lower-bound problem. On the other hand, if CBDCs do not offer any interest and negative interest rate is deemed infeasible, then the zero-lower-bound problem during economic recessions could become more pronounced and problematic for the central banks.

In case of a two-tier system, where private digital currency accounts are held at commercial banks, according to some researchers,¹³ a central bank will find it difficult to maintain monetary sovereignty and simultaneously pursue objectives of free convertibility between CBDC and bank money and parity between CBDC and bank money. Both in the one-tier and two tier systems, regardless of the interest paid on CBDC, if funds held at deposit accounts of commercial banks can be easily and instantly substituted for CBDC, even in the absence of panic among depositors and rush to convert their holdings into CBDC, commercial banks cannot be certain about the stability of their deposits and may be tempted to resort to credit rationing and charging higher risk premium on their loans. In case of a massive conversion of deposits to CBDC, the amounts of required reserves for commercial banks would also decline; this would not be matched by the decline in loans, posing risks for financial stability. However, most of these discussions remain largely hypothetical due to the lack of empirical evidence.

¹² Michael Bordo and Andrew Levin (2017), *Central bank digital currency and the future of monetary policy*, NBER Working Paper No. 23711.

¹³ Ole Bjerg (2017), *Designing New Money - The Policy Trilemma of Central Bank Digital Currency*, Copenhagen Business School Working Paper.

¹¹ See United Nations, *Financing for Sustainable Development Report 2022*.

Impact of CBDC introduction on fiscal policy

An introduction of CBDC will also likely impact the conduct of fiscal policy. On one hand, CBDC may improve fiscal policy mechanisms, by simplifying deliveries of transfer payments, for example social benefits, to the population (in many developing countries, digital cash transfers to the population already exist, but much improvement is needed),¹⁴ which may be especially important during the times of economic slowdown. CBDCs can also improve tax collection by simplifying payments and curtailing evasion. If the central bank decides to expand its balance sheet to meet an increasing demand for CBDC, it may conduct operations similar to reserve management by the US Federal Reserve, purchasing government debt on the secondary market and driving down borrowing rates, increasing fiscal space for the government. Such policies, however, may contradict the announced strategy of leading central banks of the gradual reduction of the size of their balance sheets.

Additional issues for international use

A large-scale usage of CBDCs for cross-border financial transactions will likely make it harder to regulate or restrict those financial flows, as they would likely bypass SWIFT interbank messaging systems that manage inter-bank flows. This would complicate enforcement of economic and financial sanctions on state parties. For example, the United States and the European Union have imposed large-scale economic sanctions on the Russian Federation resulting from the war in Ukraine. In particular, since March 2022 several Russian banks have been disconnected from the SWIFT system. The Russian authorities have reportedly expressed interest in using CBDC as an alternative form of payments, which may allow it to bypass the sanctions.

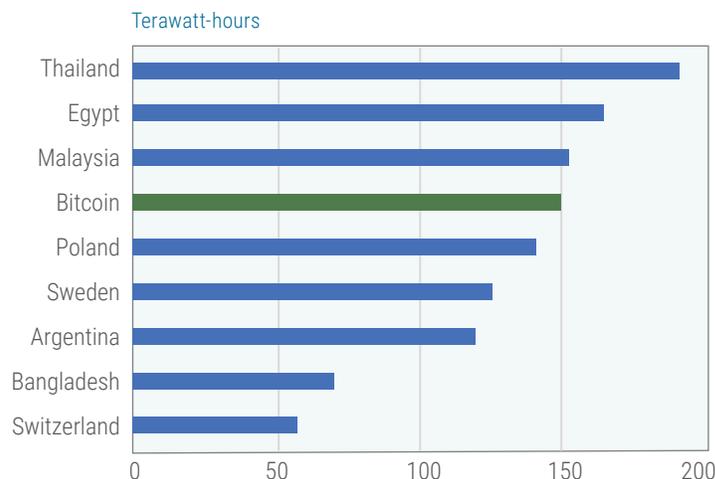
Environmental concerns

The production of cryptocurrencies requires inordinate amounts of electricity, diverting use of energy away from important economic, development and social needs, and posing a danger to the environment by implicitly contributing to higher CO₂ emissions. For example, due to its distributed ledger feature, Bitcoin, the world's largest cryptocurrency, consumes an estimated 150 terawatt-hours of electricity every year, around 0.6 per cent of the global electricity production, which exceeds the total annual electricity consumption of countries such as Argentina and Bangladesh (figure 3).

Similar concerns were expressed with respect to the CBDC, as its issuance, storage and related transactions are likely to require large amounts of electricity, causing additional greenhouse

Figure 3

Estimated annual electricity consumption



Sources: Cambridge Bitcoin Electricity Consumption Index, UN DESA Statistics Division, and national sources.

Note: Annual electricity consumption figures are based on available data for the period from 2017 to 2021.

effects and environmental degradation, unless relying on renewable energy sources. To mitigate those unwanted side effects, it is essential that prospective designs of CBDC take into account the environmental dimension, choosing such underlying technical architecture that minimizes the carbon footprint. For example, a recent study on cryptocurrencies energy consumption by the IMF¹⁵ has identified specific design choices of the crypto system that greatly influences energy needs for the supporting network. In particular, an important element determining energy consumption is the consensus mechanism – the energy needs are much higher in the case of proof-of-work (PoW) algorithms, compared with non-PoW schemes. The level of control that can be exercised over the payments system also has a strong influence on its energy consumption. Therefore, CBDCs would need to be designed with infrastructures that are less energy intensive. According to the IMF's estimates, the global payments system currently consumes 47.3 TWh annually. The central banks should aim at a lower carbon footprint, while developing digital currencies.

At this stage, despite the intensive research and several pilot programmes conducted in the area of CBDCs, no major central bank is rushing to adopt digital currencies, as there are still many unknowns. In the most plausible scenario, only a very limited implementation of CBDC will take place within the coming years, followed by careful assessment of the accumulated empirical evidence and lessons learned, before CBDCs become the dominant form of currency in the largest economies.

¹⁴ Anir Chowdhury, Cina Lawson, Elizabeth Kellison, Han Sheng Chia, Homi Kharas, Jacquelline Fuller, Michael Faye, Michal Rutkowski, Rodrigo Salvado, and Stefan Dercon (2022), *Accelerating digital cash transfers to the world's poorest*, Brookings.

¹⁵ Itai Agur, Jose Deodoro, Xavier Lavayssière, Soledad Martinez Peria, Damiano Sandri, Hervé Tourpe and Germán Villegas Bauer (2022), *Digital Currencies and Energy Consumptions*, IMF Fintech Notes 2022/006.