Invesco

Digital Currencies:
The (Coming of) Age of Central Bank Digital Currencies

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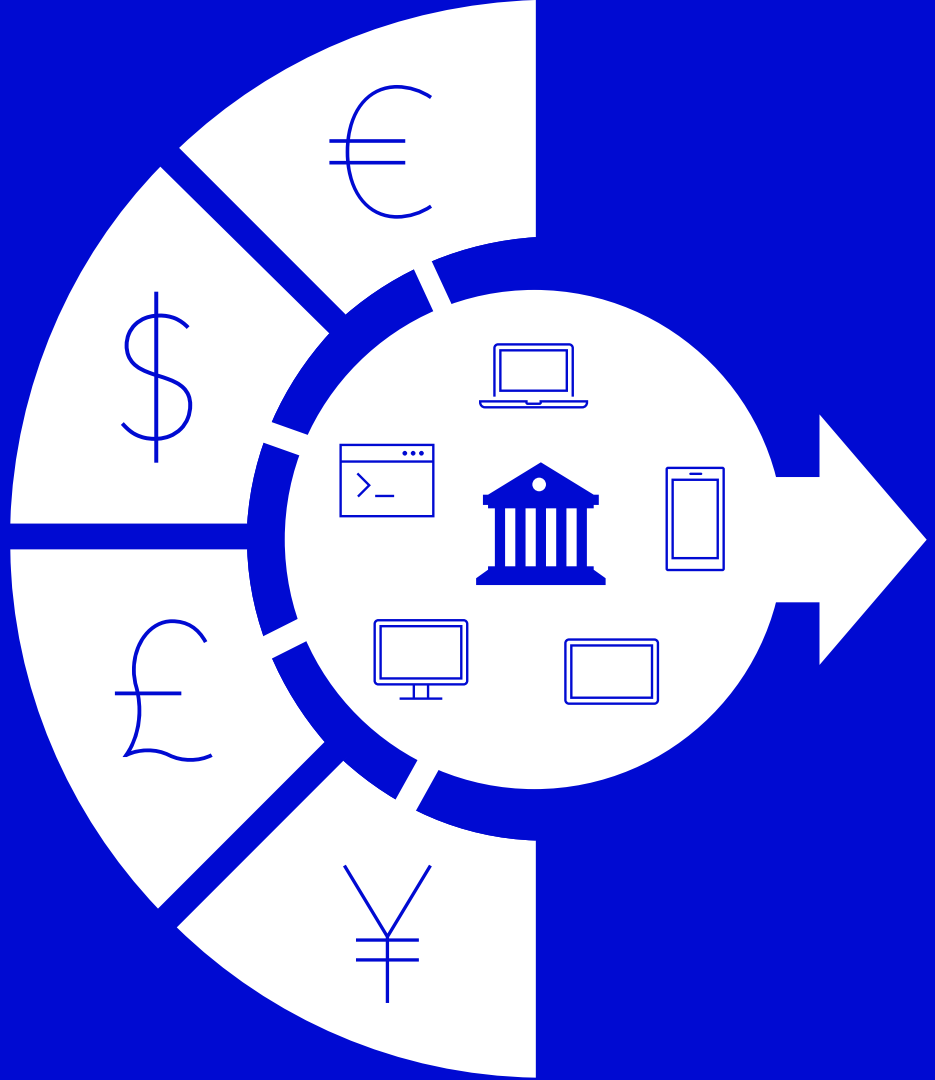


Central Bank Digital Currencies (CBDCs) Are No Longer a Fringe Fascination

Many countries are actively exploring or have already launched CBDCs

Once a pipedream of the digitalization of finance, central bank digital currencies (CBDCs) have reached a critical moment. Small states in the Caribbean have pioneered the world's first official digital currencies, while China has continued to expand its digital yuan's pilot project to the masses. 38% of central banks are actively researching a CBDC of some kind encompassing 76% of the world's population. Of those, 46% are currently conducting or have already completed a pilot program. It is our view that CBDCs are not a question of if, but when.

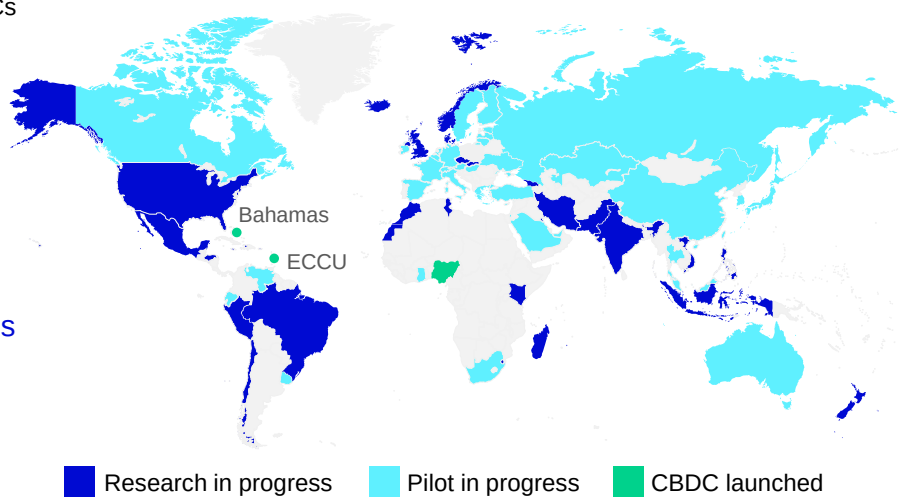
In this piece, we seek to define and explore CBDCs and assess their characteristics and their disruptive potential. We address the potential implications for monetary policy, financial markets, banking, and asset prices. We conclude with an overview of major CBDC projects, including China's digital yuan and the case for a digital US dollar or euro.

Countries Pursuing CBDCs

68
Central banks pursuing CBDC projects

28
Central banks conducting pilot programs

3
Central banks with already launched CBDCs



ECCU = Eastern Caribbean Currency Union, comprising Anguilla, Antigua and Barbuda, Dominica, Grenada, Montserrat, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines.
Sources: Auer, R, G Cornelli and J Frost (2020), "Rise of the central bank digital currencies: drivers, approaches and technologies", BIS working paper, No 880, August, latest available data as of 31 January 2022.

Why Today?

Increasing digitalization and the COVID pandemic have accelerated CBDC projects

As we explore in this piece, CBDCs are an effort by central banks to maintain access to cash in an increasingly digital age while expanding efficiencies and safety in payments systems.

However, motivating factors are different in each country. In Sweden, for example, cash has virtually disappeared. In China, the emergence and domination of 3rd party payment systems offered by Alibaba (Alipay) and Tencent (WeChat) have rivaled official channels, processing over USD$30 trillion in transactions per year.

We see the COVID-19 pandemic and the rise of cryptocurrencies – niche private digital currencies – as being the primary drivers of CBDC interest today. Policymakers also desire to maintain access to central bank money as cash fades in use.

As Federal Reserve Chair Jerome Powell said: "You wouldn't need stablecoins, you wouldn't need crypto currencies if you had a digital U.S. currency - I think that's one of the stronger arguments in its favor".

A Selection of Factors Driving CBDC Interest

Efficiency & financial inclusion

Financial services remain out of reach for many. In the US, over 5% of households remain unbanked. CBDCs may help expand access & provide cheaper services.

Declining use of cash

Even before Covid, cash was already being replaced by digital payment solutions at the till – from debit and credit card transactions to services like PayPal and Alipay.

Facilitate government payments

For policymakers, large-scale direct stimulus programs may be easier to target and execute with consumer CBDC accounts.

Increasing digitalization

Transactions are increasingly online, requiring digital payments systems. A digitally-native currency may enhance security and improve settlement speeds.

Rise of crypto-currencies

Cryptocurrencies, private digital currencies, and alternative digital payment methods have increased financial stability risks while raising concerns about the future of fiat currencies.

Private projects like Facebook's Diem (formerly Libra), stablecoins and cryptocurrencies like Bitcoin have raised particular concerns. These include money-laundering, terrorism financing, tax evasion, and etc.

Note: The T with two lines through it (₮) is commonly used to represent Tether, a kind of cryptocurrency backed by US dollar assets and intended to act as a peg to the dollar.
Sources: US Federal Reserve discussion paper, January 2022 "Money and Payments: The U.S. Dollar in the Age of Digital Transformation", and Invesco. For illustrative purposes only.

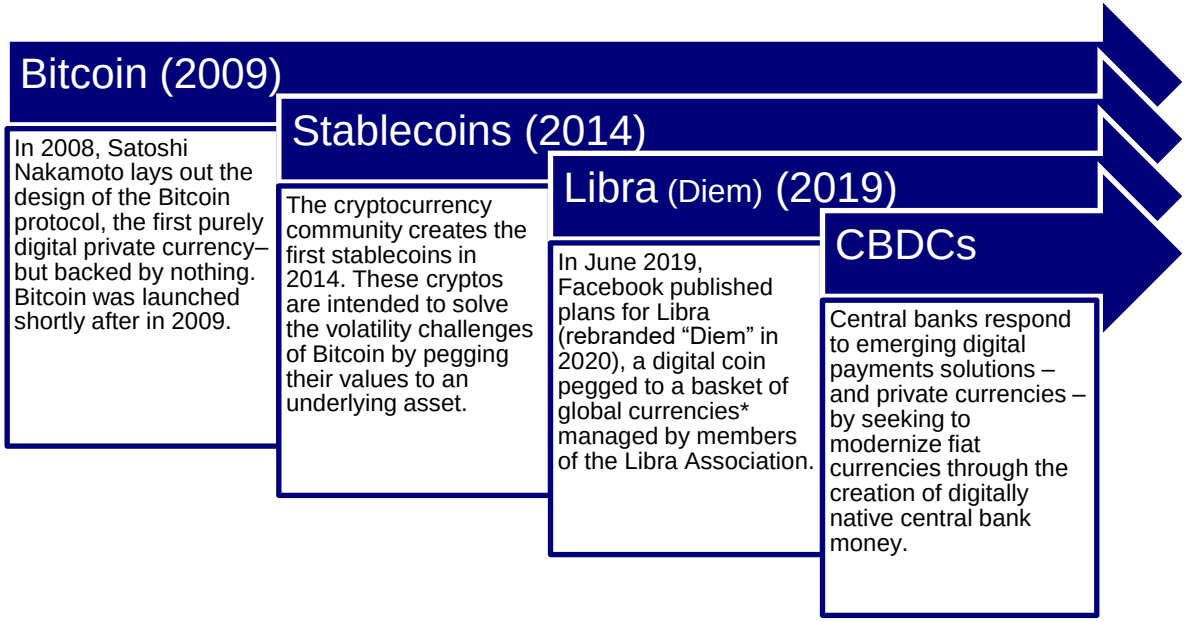
CBDCs Are Next Following Successive Waves of Payments Digitalization

Private currencies and closed payment ecosystems have given life to ‘digital money’

How did we get here? It is instructive to look to recent technological and payments developments for clues.

- Bitcoin was launched in March 2009 as a purely digital, peer-to-peer currency, issued via a protocol and operated on a decentralized ledger.
- Building on the cryptography-based tech of Bitcoin, stablecoins first emerged in 2014 with the intent of establishing a stable value in a cryptoasset by tracking an underlying asset value.
- In June 2019, Facebook’s Libra (now Diem) was announced as a basket of sovereign currencies, but issued privately. This prompted China to accelerate its own official digital currency project.

Ultimately, CBDCs seek to provide a public good like cash, capable of maintaining monetary sovereignty while promoting competition and innovation in payment solutions.



* Early reports stated that Libra’s reserves would be composed of 50% United States dollar, 18% Euro, 14% Japanese yen, 11% British pound sterling and 7% Singapore dollar. These plans were later revised in 2020 to instead have a variety of stablecoins each backed by a single currency.

Sources: Bloomberg News, Facebook press releases, Payment & Clearing Association of China, and Invesco.

Agenda

1. **What makes a CBDC?**
2. What are the key design questions for CBDCs?
3. What are the implications for the financial system?
4. Where are countries in pursuing CBDCs?
5. What are the investment implications?

What Is Money For?

Money is a way of expressing and measuring purchasing power

Money features prominently in our lives. We use it to pay for food, housing, utilities, transportation, and more. We are paid money for labor, and we use it to value goods and services in quantitative terms. Money is how we measure purchasing power.

Yet few pause to consider exactly what makes money "money." The earliest forms of currency included a variety of expressions, such as cowrie shells, coins, and eventually bank notes. Today, new formats of money are challenging the concept, as is the case with cryptocurrencies.

In economics, money has the specific characteristics of being a store of value, a unit of account, and a medium of exchange. Each of these qualities reinforces the others. For something to function reliably as money, it should have all three traits. CBDCs are intended to function as all three.

What Defines Money?

	Store of Value	Unit of Account	Medium of Exchange
	Retains purchasing power reliably through time and can be saved for future use	Reliably used for measuring the prices of goods and services without rapid adjustment	Easily used to facilitate the sale or purchase of goods and services
Cash	✓	✓	✓
CBDCs	✓	✓	✓
Gold	✓	X	X
Bitcoin	X	X	*
Stablecoin (asset-backed)	✓†	✓	✓

* While Bitcoin can only process around seven transactions per second in its current design, so-called "Layer 2" solutions offer significantly faster network throughput (e.g. Bitcoin's Lightning Network). This has permitted significant gains in maximum network throughput at the expense of some security.
† Asset-backed stablecoins are subject to the stability of the custodian. A failure of the stablecoin may result in a loss of value.
Source: Invesco. For illustrative purposes only.

What Kinds of Money Are There?

Cash, bank deposits – and CBDCs?

We often think of money as physical currency or deposits held in a bank account, with the assumption that these are one and the same. But there are important differences.

Money as we know it today comes in many forms. Bank deposits, the most familiar kind of money to everyday consumers, represent a liability of a commercial bank. In the past – and in some nations today – a bank that goes bust can take the deposits of households and businesses with it. Deposit insurance schemes were designed to help assure depositors of the safety of their funds and cover an amount of losses in the event of a bank's failure.

Physical cash, on the other hand, is not exposed to the risk of failure of a private institution*. Cash is a liability of the central bank, which is the issuer of the currency and recognized by the government.

CBDCs, as we will see, are simply a digital version of physical cash – or digital central bank money.

Different Formats of Money

Cash

- *Issuer*: Central bank
- *Underlying Value*: Trust in and backstop of government

Gold

- *Issuer*: None
- *Underlying Value*: Belief in permanence of value, as shown through history

Bitcoin

- *Issuer*: Digital protocol
- *Underlying Value*: Belief in permanence of value, but with limited history

Demand Deposit

- *Issuer*: Commercial banks
- *Underlying Value*: Promise of convertibility to cash

Digital Payments Balance

- *Issuer*: Private firm/fintech
- *Underlying Value*: Promise of convertibility to demand deposits

Stablecoin

- *Issuer*: Private firm
- *Underlying Value*: Promise of convertibility to underlying asset

*Note that cryptocurrencies such as Bitcoin are subject to extreme price volatility as they have no asset backing. Stablecoins are subject to failure if the underlying institution that maintains the pool of underlying assets becomes insolvent.

Sources: Invesco, Tether press releases.

Defining a CBDC

A liability of a central bank, like bank reserves and currency in circulation

Formats and definitions vary widely, but the singular defining trait of a central bank digital currency is that they are a direct liability of a central bank, distinguished from physical banknotes and reserve balances. Indeed, CBDCs are “a new form of money, issued digitally by the central bank and intended to serve as legal tender.”

Consider that the main liability of a central bank is the “monetary base” (M0), which has historically consisted of currency in circulation and bank reserves. CBDCs could complement currency or potentially replace it—and they could even supplant bank reserves.

Keep in mind that central bank money is unique. Since it is the liability of the central bank, and not a private institution, it is not subject to the same risks as other kinds of money. Digital payments services, commercial banks, stablecoins, and other such kinds of money have some kind of issuer that is liable to default and does not enjoy the backing of the state.*

A Central Bank Balance Sheet with a Central Bank Digital Currency

Assets	Liabilities
Monetary outright holdings	Bank Reserves (Required or “Excess”)
Collateral for liquidity-lending via repos	Reserves (commercial bank deposits)
Non-monetary assets (FX reserves, gold, IMF credit)	Banknotes & coins
	CBDC

To date, most central banks have stated that they do not wish to phase out physical cash

* Commercial bank deposits are often backed in part by a deposit insurance scheme, which is designed to protect and reassure depositors in the event of a bank failure or perceived bank weakness. Note also that some stablecoins are asset-backed, meaning that there is some governing institution that maintains a deposit base to promise convertibility to the reference asset.
Sources: Casting Light on Central Bank Digital Currency, IMF Staff Discussion Note, November 2018.

Are CBDCs Just Stablecoins?

CBDCs are a direct liability of a central bank – not a private institution

With the emergence of the world's first cryptocurrency, Bitcoin, a new form of digital payments that are fundamentally decentralized in their design have garnered increasing attention. However, a key issue was the extreme volatility of Bitcoin's price. So-called stablecoins arrived as a potential solution in 2014. These coins seek to track the value of an underlying asset, typically by being backed by a pool of those assets. Are CBDCs, then, just stablecoins pegged to an official currency?

Not quite. Comparing stablecoins and CBDCs is a bit like comparing a money market fund to cash. A money market fund invests in a pool of assets, with the objective of earning a return while maintaining a stable net asset value. Cash, on the other hand, represents a direct liability of a central bank. While it can be debased via increases in the money supply, it is ultimately a highly reliable store of value.

A CBDC is similar to cash, with the defining difference being that it is entirely digital.

Comparing Central Bank Digital Currencies vs. Select Cryptocurrencies

	Tether Stablecoin	**Bitcoin** Traditional cryptocurrency	**CBDC** Central bank digital currency
Based on Blockchain	Yes	Yes	Potentially*
Issuer	Tether, a business, issues tokens	Decentralized protocol	Central bank
Intended Use	Represent transactions of fiat currency on a blockchain	"Store of value" with a fixed supply and a decentralized ledger	Supplement to physical cash for wholesale or everyday payments
Source of Value	Underlying pool of assets, similar to a money market fund	None. Value is free-floating and determined by markets	A direct liability of a central bank like cash

*Some designs include use of distributed ledger technology (DLT). Note that CBDCs using DLT do not entail 'mining' of coins via a consensus mechanism, as in cryptocurrencies like Bitcoin.
Sources: Invesco, Tether press releases.

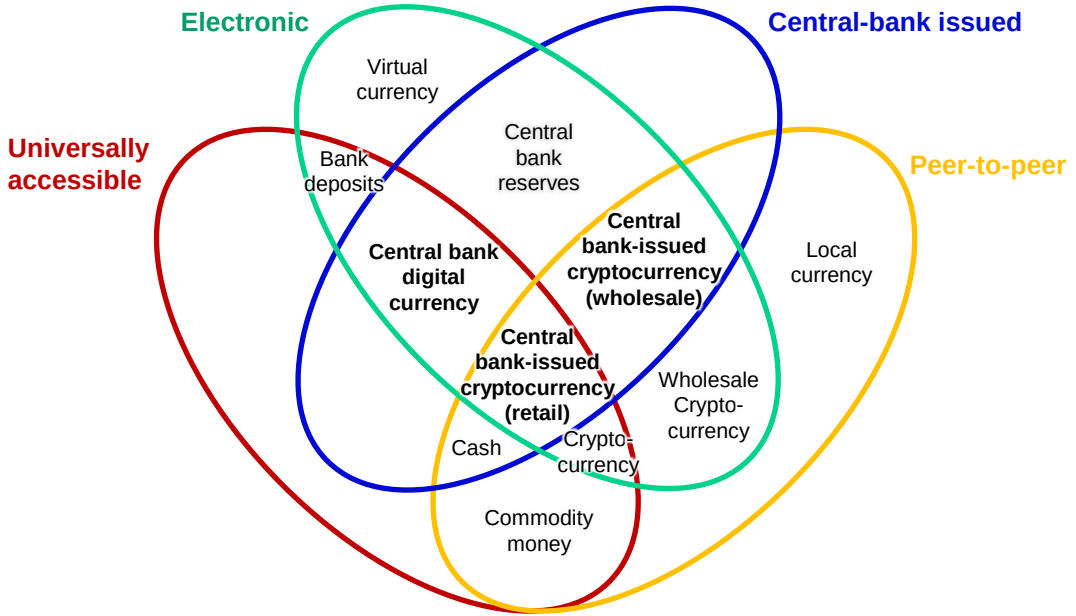
The Many Meanings of Currency

CBDCs are central bank-issued, peer-to-peer, electronic, and universally accessible

To illustrate the difference between CBDCs and cryptocurrencies, we like to use the visualization on the right to depict the varying classifications of money in terms of whether the money is universally accessible, electronic, central bank-issued, and peer-to-peer.

Importantly, cryptocurrencies are specifically outside the control of central banks, whereas CBDCs are central-bank issued. Indeed, decentralized cryptocurrencies are reminiscent of the pre-Civil War era of "free banking" in the United States, when private banks were easily established and offered their own bank notes without central regulation, or a central bank. It is worth noting that the US has repeatedly experimented with central banking and operating without a central bank. A lack of financial stability and repeated boom-bust cycles culminating in depressions led to the establishment of the Federal Reserve system, and after the Great Depression, to active monetary policy.

"The Money Flower" – A Taxonomy of Money



Sources: Bank for International Settlements, Wikipedia. Adapted and reproduced from *Central bank cryptocurrencies* by Morten Linnemann Bech and Rodney Garratt.

Is This Just Another Digital Payments Service?

CBDCs may offer a central bank-based payments solution via digital cash

If not stablecoins, can we instead consider CBDCs as a state-sponsored digital payment service? Perhaps—though a better analogy is to think of them as a digital form of physical banknotes and coins.

To compare, we must first consider other forms of central bank money. Take, for example, cash and bank reserves. Physical banknotes and coins are a physically formatted bearer instrument that represents a claim on a central bank. While cash is universally accessible, it is constrained in its utility by its being physical.

On the other hand, bank reserves are an account-based digital liability of a central bank. But their access is extremely restricted, with only select member banks able to establish and transact with such accounts.

CBDCs, therefore, are somewhere between cash and bank reserves. CBDC designs may also include a central bank-operated digital payment mechanism. However, as we explore further in this piece, CBDCs may not necessarily be accessible to the general public.

Comparing Payment Systems

Bank Transfer	Fintech Payments	CBDC
Banks exchange **bank deposits** with one another at the request of customers	Fintechs act as virtual financial inter-mediaries & **represent exchange of bank deposits** on digital ledgers	**Central bank liabilities** are exchanged across client accounts on the central bank's ledger.
Payer requests transfer of funds ↓ Payer's bank transmits funds to payee's bank ↓ Payee's bank receives funds and reflects change of balance ↓ Payee can see funds transmitted by payer	Payer requests transfer of funds ↓ Payer's bank transmits funds to fintech's bank ↓ Fintech shows credit on payer's account, which can be sent to payee on the platform ↓ Payee withdraws funds from fintech to their bank account ↓ Payee can see funds in their bank account	Payer transfers funds directly via exchange of CBDC ↓ Payee receives funds in digital CBDC wallet *(Models vary)*

Source: Invesco. For illustrative purposes only.

What's the Point?

The Potential for Efficiency Gains Is Substantial

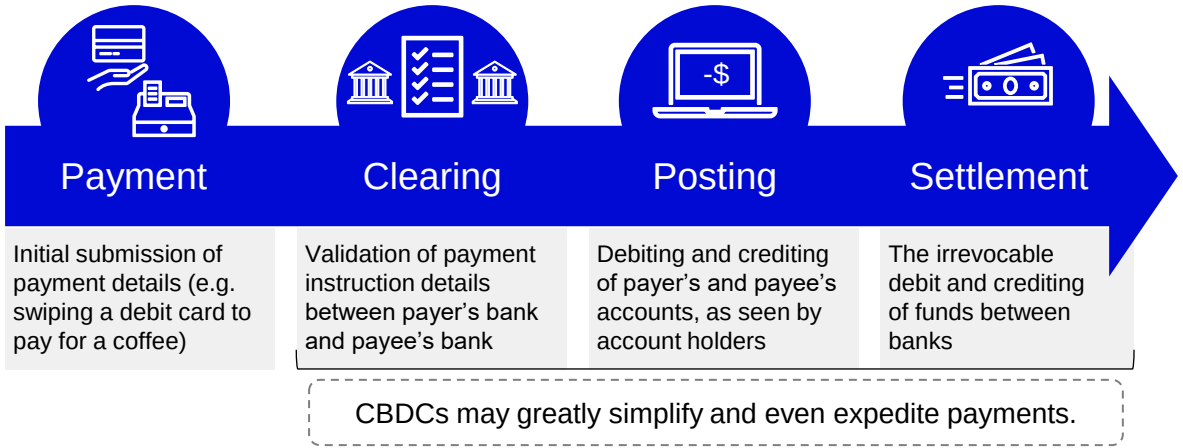
CBDCs offer the opportunity to reform payments in meaningful ways

A 2015 SWIFT paper noted that "regulators believe that faster payments will accelerate economic growth – if a business is paid in real-time, it will be able to speed up its cash conversion cycle, generate necessary working capital, and reduce its need for expensive short-term financing."

Indeed, in many economies, payments remains a dreadfully slow process. With the advent of so many technologies in recent decades, it is striking that financial systems have been slow to change. With today's technology, we may send digital messages to users across the world in a fraction of a second, and yet a digital bank transfer may take days to clear.*

CBDCs present a substantial opportunity to expedite and simplify the process by which funds are transferred by allowing real time exchange of central bank money across institutions while mitigating points of failure in payments systems. And all this can be accomplished within a framework backed up by a nation's central bank.

Stages of Payment



*Note that a number of economies already have instant payment systems that facilitate the rapid exchange of funds in near real-time, notably the United Kingdom's Faster Payments Service.
Sources: Invesco, 2015 SWIFT white paper: The Global Adoption of Real-Time Retail Payments Systems. For illustrative purposes only.

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How Do I Hold a CBDC? A Token or Account-Based Model

Tokens are similar to cash, while accounts are more like checking accounts

Today, the most familiar ways in which we hold money are either as physical cash or as a deposit in a bank account. Let's assume a central bank decides to issue a CBDC accessible to the general public. How would the average person hold it?

CBDC designs can choose to either approximate physical cash or the central bank can essentially offer bank accounts. In the first model, holdings of cash may be identified through tokens, similar to the design of Bitcoin. The authenticity of the tokens would be the only verification processed in a transaction (in other words, not the identity of the holder). In contrast, an account-based model would rely on ascertaining the identity of a user and whether they have permission to access the account.

These designs can have important implications for where one may store their CBDCs and its impacts on financial intermediation. The following slides detail additional considerations in designing a CBDC.

Comparing the Characteristics of Different Kinds of Currencies

CBDCs are backed by central banks, a particularly attractive feature in periods of financial distress

		Account-Based	Token-Based	
			Digital	Physical
Issuer/ Backstop	Central bank	Central bank reserves	Token-based CBDCs	Banknotes/ coins
		Account-based CBDC		
	Commercial bank	Bank deposits	Bank digital currencies	
	Private	Payment provider	Stablecoins	Prepaid cards
	None		Bitcoin, most crypto-currencies	Precious metals

Sources: Goldman Sachs Global Investment Research and Invesco. For illustrative purposes only.

CBDCs Have Numerous Design Choices

While CBDCs are united in name, they can have many forms

Select Operating Hours or 24/7 Availability

Currently, access to central bank money is largely confined to the operating hours of the central bank.

A CBDC could be designed to have greater operating hours in a wholly digital ecosystem – even 24/7/365.

User Identification or Anonymity

Similar to the offline, anonymous nature of cash transactions, a CBDC could be designed to provide anonymity for the user. On the opposite spectrum, it could also introduce greater oversight.

(Further details in Appendix 2.)

Centralized or Peer-to-Peer

Cash is central bank money and is traded peer-to-peer, without need for an intermediating party. Bank balances, in contrast, are transferred provisionally between banks and then settled via transfers of central bank digital balances (reserves) between banks.

A CBDC could enable a faster transfer mechanism by making bank transfers direct and final.

Interest Free or Interest Bearing

Similar to how bank reserves can be paid interest by central banks, a CBDC could be designed to include a policy rate mechanism whereby interest is paid on – or even taken from – CBDC balances.

An interest-free design may help enforce the zero lower bound, while an interest-paying design may facilitate negative interest rates and provide control over CBDC incentives.

Unlimited Use or Capped Use

Caps or limits can be constructed as part of the CBDC to limit its use. For example, a retail CBDC could constrain the total balance a user may hold to encourage more traditional deposits at commercial banks.

This may aid in allaying digital bank run fears, but also poses issues in the desired one-for-one convertibility of a CBDC to bank deposits.

Source: Invesco. For illustrative purposes only. This list is not exhaustive.

The Fundamental Issue: Preserving Intermediation

Level of state involvement determines degree of disintermediation

While there are a multitude of considerations in how exactly a CBDC may be executed, perhaps the most important among them is how a CBDC may affect the role of financial intermediaries in an economy. This may at first seem like a theoretical roadblock, but the implications may be significant.

The financial sector plays a vital role in allocating capital to the most efficient and productive opportunities. Greater state involvement—whether through government fiscal schemes or a bloated central bank—limits the role of the financial sector and, theoretically, contributes to a less healthy market mechanism. Too much state involvement may also limit the role for maturity transformation as carried out by banks.

Any CBDC project must therefore consider the potential impact on the financial sector. In the following slides, we explore the common design themes of CBDCs and how they may impact financial intermediation.

What Is Intermediation?

Defining Intermediation

The level of financial intermediation describes the degree of involvement of financial intermediaries such as banks. Greater intermediation increases the market's role in the efficient allocation of capital but decreases the power of the government.

More or less intermediation

How Does a CBDC Factor in?

A CBDC is a liability of the central bank. Liabilities of a central bank must be matched by an increase in central bank-held assets. Therefore, CBDC issuance would require a larger central bank balance sheet – and thus a greater role in markets.

Assets	Liabilities
Gold	Reserves
Foreign currency	Banknotes
Repo collateral	Coins
+ Assets	**+ CBDCs**

Source: Invesco.

Three Broad Design Approaches for CBDCs

Design yields varying impacts on financial system

Retail / "Direct" CBDC

Individuals and businesses hold the CBDC directly via an account with the central bank (account-based) or by holding tokens in a digital wallet, much like holding physical cash (token-based).

(+) Potentially greater banking access
(+) Faster & more efficient settlement
(–) May pull deposits from banking system, disrupt liquidity/maturity transformation, and increase cost of credit
(–) Potentially unforeseen complexities

Unlikely choice in financialized economies.

vs.

Hybrid CBDC

The CBDC is a cash-like direct claim on the central bank, but the private sector manages customer-facing activity and distribution through so-called "payment service providers."

(+) Faster & more efficient settlement
(+) Potentially reduced counterparty risk
(+/-) Some impact on existing financial structure and business models
(–) Potentially unforeseen complexities

Most common model.

vs.

Wholesale / "Indirect" CBDC

Similar to bank reserves but more tradable. Banks hold CBDCs and transact them with other banks to represent final transaction settlement.

(+) Faster & more efficient settlement
(+) Potentially reduced counterparty risk
(+) Little to no impact on existing financial structure and business models
(–) Few benefits versus existing models
(–) Potentially unforeseen complexities

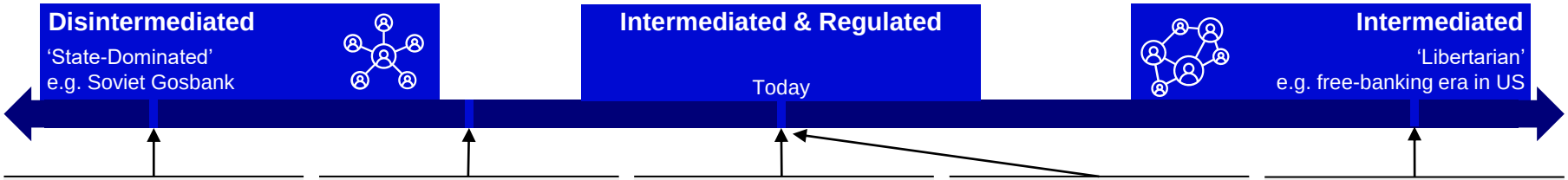
Perceived benefits are minimal.

More change — Anticipated Degree of Change of Financial System — *Less change*

Source: Invesco. The above represent stylized CBDC designs. Actual CBDCs may have characteristics that vary from these descriptions.

The Fundamental Issue: Preserving Intermediation

Level of state involvement determines degree of disintermediation



Pure Retail CBDC "Direct CBDC"

- Central bank operates retail accounts for all persons capable of holding CBDCs, or distributes CBDCs in a manner similar to cash.
- Widespread access may transform role of banks.

Financial System Impact
Very High*

Hybrid CBDC

- Central bank issues CBDCs for use by households, but CBDCs are distributed via financial intermediaries.
- Likely to maintain the role of banks.

Financial System Impact
Medium

Wholesale CBDC

- Replaces bank reserves with CBDCs in bearer format. Only select financial institutions can access.
- Likely to be operationally smoother for banks, with few other changes.

Financial System Impact
Low

Bank Reserves

- Banks maintain reserve accounts with the central bank and undertake lending (a la fractional reserve banking).
- This is the current state.

Financial System Impact
➡ *Current State* ⬅

DeFi / Cryptos

- Traditional financial intermediaries are displaced by a plethora of decentralized protocols that carry out similar functions

Financial System Impact
Very High

* See Appendix 3 for a hypothetical analysis.

Sources: Invesco. For illustrative purposes only. Financial system impact is assessed by the author and does not constitute a specific forecast or expectation of the future.

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The Potential Benefits of a CBDC

Positive effects of a CBDC are determined largely by its design

CBDC advocates have pointed to numerous potential benefits stemming from a digitalization of fiat currencies. Most popular among these are improved payments efficiency and expanded financial access for households underserved by the existing financial system.

Recent research highlights a wide-ranging set of implications, including effects on payments systems, potential socioeconomic benefits, new and expanded tools for policymakers, competitive and innovative potential, and other systemic effects.

Potential Benefits of Central Bank Digital Currencies May Include…

Payments & Settlement Improvements
- Expanded operating hours for settlement
- Potentially easier cross-border payments
- Less counterparty risk for payments intermediaries and potentially safer payments infrastructure
- Faster settlement with lower costs

Financial Inclusion
- A retail CBDC may enable greater banking access, driving broader financial inclusion

Improved Data Capabilities
- May enable real-time economic data
- Transactions may be anonymized to comply with privacy regulations

Continued Access to Central Bank Money
- A central bank digital currency may be a digital supplement to cash
- May address secular decline of cash and rise of private digital payments systems

Additional Policy Capabilities
- Expanded options in monetary policy
- Facilitate transmission of fiscal policy

Competitive & Innovative Potential
- May help foster innovative changes
- May support competition in payments

Source: Invesco. For illustrative purposes only. The ultimate design of any CBDC will ultimately shift the calculus of potential benefits.

CBDCs are Not Without Risks

Policymakers – especially in developed economies – are wary of unintended effects

However, while CBDCs have many advocates, there are also a variety of concerns about how digital currencies – especially if widely available to the public – may affect the financial system. Top among these are fears of how bank funding may be affected. As central bank money would inherently be less risky than demand deposits held at commercial banks, the fear is that users would reduce their deposits at commercial banks and shift them to the central bank – especially in periods of crisis.

Such financial stability effects are explored in some further detail on the right. Other risks may include cybersecurity and resiliency of CBDC infrastructure, how a larger central bank balance sheet may affect markets, and – perhaps most importantly – the Rumsfeldian "unknown unknowns" that may plague projects that come to fruition.

Potential Risks of Central Bank Digital Currencies May Include…

Financial Stability Fears
- A publicly accessible retail CBDC may pull deposits from banks as central bank accounts (or cash) may be viewed as safer than zero-yielding demand deposits
- May facilitate "digital bank runs" in times of financial stress

Reduced Financial Intermediation
- A retail CBDC may require a greater role of the central bank in markets (see Appendix 3)
- Such a CBDC is likely to increase the size of the central bank balance sheet, forcing central bank to play greater role in maturity and liquidity transformation

Cybersecurity Risks
- Increasing digitalization, especially if centralized, may heighten cybersecurity risks

Potential to Shift Market Yields
- Publicly accessible CBDCs may shift funding dynamics, esp. for banks, impacting required rates of return on Treasury bills, ONRPs, and/or retail deposits
- Fewer deposits at commercial banks may result in more expensive bank credit

Unforeseen Consequences
- May create favored forms of money – CBDCs may compete with bank- and deposit insurance-backed deposits
- And other considerations not seen today…

Source: Invesco. For illustrative purposes only. The ultimate design of any CBDC will ultimately shift the calculus of potential risks. ONRPs = overnight reverse repurchase agreements.

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How Far Along Are CBDCs Projects?

The world has not seen a significant, large-scale CBDC yet – China likely to be first

The Bank for International Settlements notes that "central banks collectively representing a fifth of the world's population are likely to issue a general purpose CBDC in the next three years." Some small central banks, notably in the Caribbean, have already issued CBDCs. The largest and most advanced project underway is China's digital currency/electronic payments (DC/EP), its own home-brewed CBDC.

Despite 68 of the world's central banks working at some kind of CBDC, most projects remain at their earliest stages. We observe that developed market central banks are particularly reluctant to roll out CBDCs. In general, more financialized societies tend to be slower to adopt new financial technologies, likely due to the strength of incumbents and the difficulty involved in shifting involved infrastructure.

We therefore expect emerging market economies to lead the way in CBDC projects.

Selected CBDC Projects Across Countries

The Pioneers *CBDC launched*	The Up & Coming *CBDC pilot underway*	The Laggards *Research underway*
The **Bahamas** (Sand Dollar) – Launched 2020.	**China** (DC/EP*)	**Eurozone** (Digital Euro)
Eastern Caribbean Currency Union (DCash) – Launched 2021.	**Russia**	**US** (Digital Dollar)
Nigeria (e-Naira) – Launched 2021.	**Saudi Arabia**	**UK** (E-pound)
	South Korea	**Japan** (Digital Yen)
	Sweden (E-krona)	• …and 52 other countries
	• …and more (South Africa, Anguilla, Hong Kong, Jamaica, Malaysia, Singapore, Thailand, Ukraine)	

* DC/EP = Digital Currency / Electronic Payment

Sources: The Atlantic Council; Auer, R, G Cornelli and J Frost (2020), "Rise of the central bank digital currencies: drivers, approaches and technologies", BIS working paper, No 880, August, latest available data as of 31 January 2022; Invesco; and central bank press releases, speeches, and reports as of 30 April 2022.

China's DC/EP Is the Largest CBDC Project

e-CNY is not likely to result in global adoption of CNY as a reserve currency

China's CBDC has led the space with large-scale pilots underway in many cities, with reports of more than 260 million accounts opened already. Indeed, the PBoC looks to be nearing the official launch of the so-called digital yuan in the not-distant future.

According to PBoC reports, the DC/EP model will add a layer to the payments system, existing side-by-side with bank deposits in a two-tiered system. Individuals and businesses would have a balance in their account, maintained via banks with ownership verified in a central ledger by the PBoC. Bank intermediaries would handle operational aspects.

China appears to be focused on the retail angle given its large informal economy. This is likely to aid in the crackdown on corruption and tax avoidance.

While China has already started international projects with some countries, we do not expect that the yuan will benefit internationally as a reserve currency as a result of the DC/EP. China would likely need to undertake market-oriented reforms, develop well-regulated financial markets, and eliminate capital controls to achieve reserve currency status for the yuan.

China's "Digital Yuan" Features at a Glance

Intermediated
Commercial banks will distribute the DC/EP, but it will be separate from existing account balances.

Tiered Anonymity
Greater identification provided enables higher value transactions.

(See Appendix 2)

Programmable?
PBoC officials have not clarified whether DC/EP balances will be programmable, leaving door open to time-expiring balances.

Hybrid Ledger
Use of centralized ledger technology in concert with distributed ledger technology, partly to aid offline payments.

Interest-Free
Balances of DC/EP are not currently intended to be interest-accruing.

Traceable Flows
A degree of data transparency will allow policymakers to understand path of transactions, similar to cryptocurrencies.

Smart Contracts?
Smart contract may be allowed for commercial institutions to develop related applications.

Offline-Enabled
When internet access is unavailable, DC/EP can still be used. Transactions are recorded to ledger when online again.

Sources: Goldman Sachs Global Investment Research, Gao Hua Securities Research, as of 31 March 2022. Features are subject to change.

Visions for Developed Market CBDCs Already Have Constraints

A slow move towards intermediated CBDCs seems likely

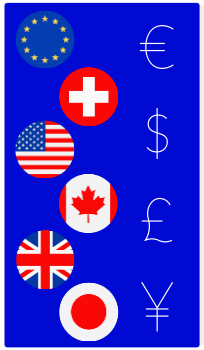
Little has been revealed by major developed market central banks. A 2020 joint publication released by the Bank for Internal Settlements noted certain priorities, as shown on the right. A recent Federal Reserve discussion paper sought to lay out points for further inquiry and research. For now, we are left to wonder over how these projects may evolve, but we can make some general statements.

We believe retail CBDCs are the least likely outcome in developed economies. A digital dollar, pound, or euro is unlikely at present to facilitate accounts opened directly with the central bank. We see the central bank ledger as being sacrosanct, available only to banks.

A hybrid CBDC is a more likely outcome, with banks serving as intermediaries and a distribution network. But it remains to be seen how retail bank deposits will be handled in this environment.

A wholesale CBDC appears to be the safest and easiest option, but this may yield few of the positive impacts we have laid out in this paper.

Countries Pursuing CBDCs



Foundational Principles

1. **Resiliency.** It must be resilient and secure to maintain operational integrity.
2. **Utility & Convenience.** To provide utility to users, a CBDC must be convenient and available at very low or no cost to end users.
3. **Minimize disintermediation.** CBDC system should have an appropriate role for the private sector and be set up to promote competition and innovation

Sources: Bank for International Settlements, October 2020 “Central bank digital currencies: foundational principles and core features”, US Federal Reserve discussion paper, January 2022 “Money and Payments: The U.S. Dollar in the Age of Digital Transformation”, and Invesco.

Agenda

1. What makes a CBDC?
2. What are the key design questions for CBDCs?
3. What are the implications for the financial system?
4. Where are countries in pursuing CBDCs?
5. **What are the investment implications?**

Investment Implications

Impacts are concentrated in retail CBDCs, while hybrid format remains murky

Drawing investment implications is difficult when CBDCs are still mostly proposals. While design implications may vary quite dramatically, we can still seek to make broad statements about the effects CBDCs may have on certain investments.

Stablecoins are most likely to be affected by the advent of CBDCs. We expect that CBDCs would help bring greater clarity to how regulators and policymakers approach the cryptocurrency space.

CBDCs may have material impacts on banks, money markets, and the ways in which institutions fund themselves. Banks may have to contend with structurally lower profitability as a result of having to raise interest rates to attract deposits. The expanded availability of central bank money may also present opportunities for non-banks, especially for fintechs.

This may also cause an expansion of risk-seeking behavior with implications for financial stability, leading to more volatile bank balance sheets or/and an absolute reduction of the size of bank balance sheets and an increasing role of the central bank.

Types of CBDC and Their Assessed Impact on Selected Investment Themes

	Cryptos	Yields	Banks	Non-Banks
Retail 'Direct' CBDC	Significant impact, especially for stablecoins. With official digital money, regulators may feel emboldened in constraining stablecoin use	As bank funding may be disrupted, banks may seek to raise a greater share of funding from financial markets and charge higher yields on bank credit	Structurally lower profitability due to disruption of key bank funding source. May also enable digital bank runs during crises	Fintechs may benefit by having easier access to central bank money and reduced needs for commercial banking, potentially enabling new opportunities
Hybrid 'Indirect' CBDC	Likely the same as above	Unclear	Unclear whether banks will be able to make use of CBDC deposits they hold on behalf of customers	Likely similar to above
Wholesale CBDC	Little to no effect	Little to no effect	Improved plumbing of payments may present opportunity to reduce some transaction fees and could impact profitability, esp. around international transfers	Wholesale CBDCs may enable new fintech products in partnership with banks

Source: Invesco. For illustrative purposes only. There is no guarantee that the assessment above will come to pass.

The CBDC Outlook: The Momentum Is Here

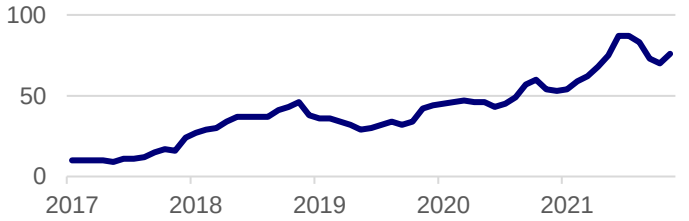
CBDCs have garnered increasing attention and net positive sentiment

In our view, central bank digital currencies are a matter of when, not if. We expect CBDCs to be rolled out in major economies (USD, CNY, EUR, GBP), but the time horizon for this is highly uncertain and variable across countries.

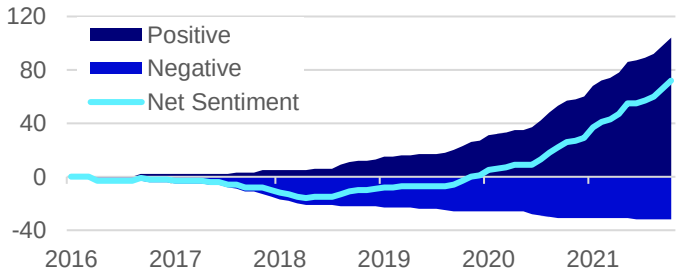
Broadly, we expect CBDCs to be introduced in a manner that does not disrupt the intermediating functions of banks. Moreover, economies where the state has a prominent role (e.g. China) are more likely to favor CBDC designs that include data-gathering elements (i.e. less anonymity is likely).

Cryptocurrency advocates, meanwhile, are likely to not find any CBDC project to be a replacement for decentralized digital asset projects. However, states may be emboldened in regulating stablecoins once a viable CBDC is launched.

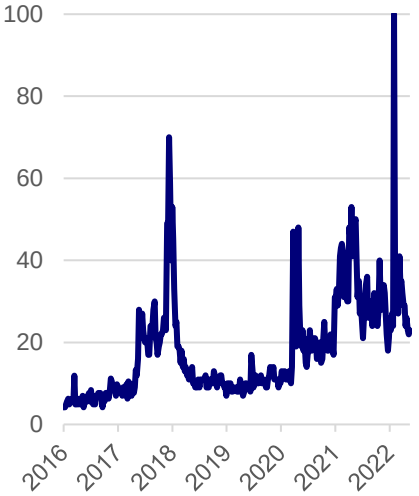
Speeches by Central Bankers on CBDCs, 12-month Rolling Sum



Sentiment* of Speeches by Central Bankers, Total Since 2016



Google Search Interest for "Digital Currency" (Highest = 100)

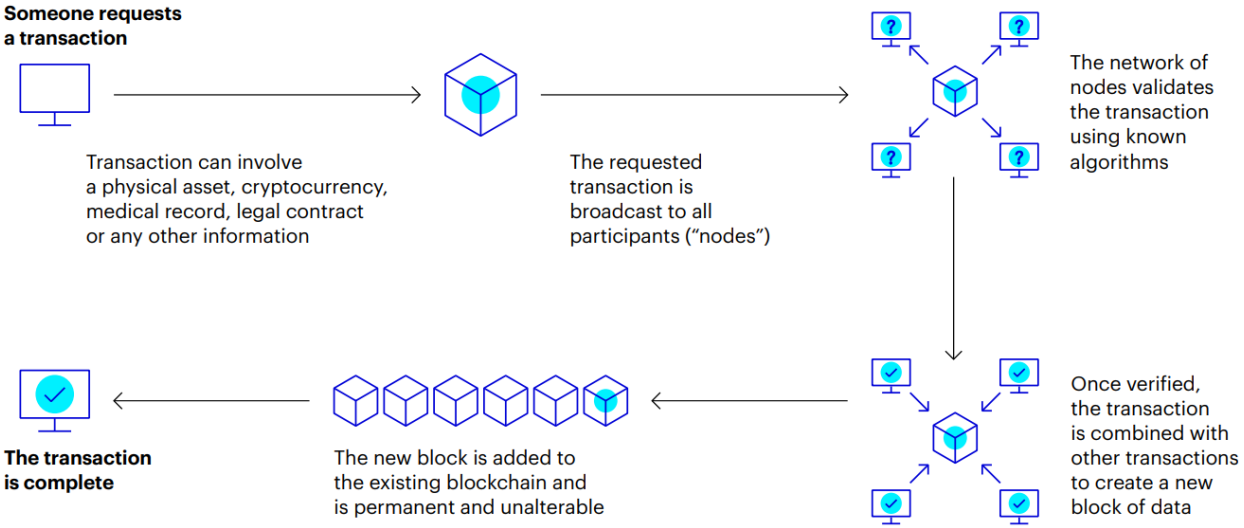


*Sentiment indicates an assessment of sentiment towards CBDCs as assessed by the source authors (see below). 1 = positive; -1 = negative. Neutral sentiment speeches were excluded.
Sources: Left: Bank for International Settlements, reproduced from Auer, R, G Cornelli and J Frost (2020), "Rise of the central bank digital currencies: drivers, approaches and technologies", BIS working paper, No 880, August. Data latest available as of 31 January 2022. Right: Google, as of 17 May 2022.

Appendix

“Digital Assets” Describe Assets (and Representations of Them) that Make Use of Cryptography & Decentralization

How Blockchain Works



My keys, my crypto!

Digital assets make use of cryptography to secure transactions. On a blockchain, each user has a public identity—a **public key**—with which your transaction data is associated and visible to all on the network. This public key is like your blockchain username.

In order to spend your crypto or transfer your digital asset, you must authorize it by submitting your **private key** as part of a transaction. This is similar to a bank PIN.

Through some complex math, the pairing of your private and public keys allow the blockchain to verify that you are the valid owner of that digital asset and can transact with it.

For illustrative purposes only.

Comparing Anonymity of Blockchains and Central Bank Digital Currencies

Blockchain

Pseudonymous "the Bitcoin model"	Users are represented by a unique virtual address with which they send and receive digital assets. Transactions are publicly known and traceable. Identities can be uncovered by known associations.
Anonymous "the privacy coin model"	Similar to the pseudonymous model, users are represented by a unique virtual address. However, this address changes after specified conditions. Transaction data is also obfuscated by mixing the true transaction details with decoy data, thus burying the true sender and receiver details.

Central Bank Digital Currencies

Model 1: Pseudonymous "the Bitcoin model"	Users can transact CBDCs in a peer-to-peer environment, where users have an identity on a network but are not otherwise known to one another unless revealed. Transactions would be traceable, and user identities may be able to be revealed based on known associations (e.g. a connection to a bank account).
Model 2: Tiered anonymity "the Chinese model"	Maximum account balances and permitted transaction amounts and volumes are determined by the degree of identifying details provided. Users can be fully anonymous if making only minimal use of the CBDC, whereas users wishing to conduct high-value transactions would need to provide and have confirmed their appropriate identifying documents.
Model 3: Identified users "the banking model"	Similar to a bank account, users would need to provide documents to prove their identity before being allowed to use any CBDCs.

Source: Invesco. For illustrative purposes only. Applicable laws and regulations may vary in different regions and localities.

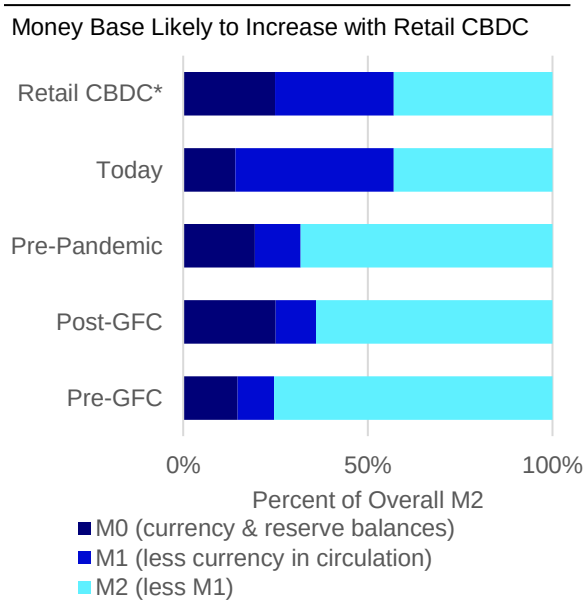
Fed May See Substantially Greater Role in Markets under Retail CBDC

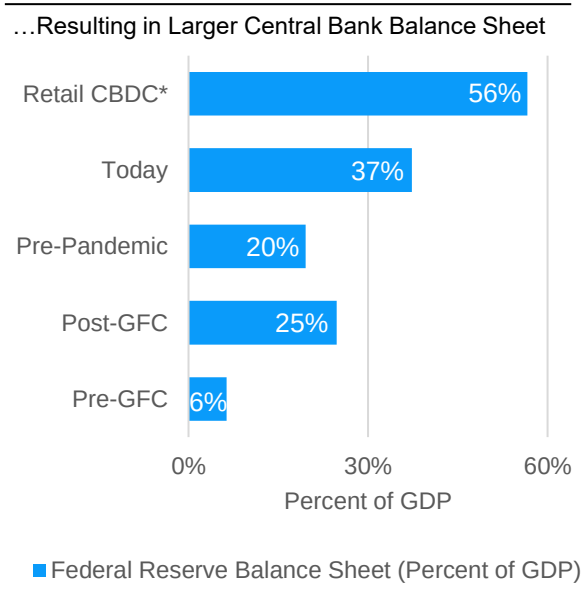
A retail CBDC may be the next balance sheet booster

In the event of a retail CBDC being issued and widely accessible to the public in the United States, we would expect a marked increase in central bank assets. In the figures on the right, we consider what would happen if 25% of demand deposits were converted immediately today to a retail CBDC.

The result is sobering. By this admittedly simplistic analysis, a retail CBDC would increase the Federal Reserve balance sheet to be 56% of GDP, up nearly 20 percentage points from today's level. Such a change would imply likely lower yields and a more commanding role in the markets for the central bank.

Such possibilities merit further consideration by policymakers interested in launching a retail CBDC.





*Retail CBDC is a hypothetical case where 25% of demand deposits are substituted into a retail CBDC. In this study, this reduces M1 and increases M0, theoretically requiring an expansion of Federal Reserve assets to accommodate the increase in liabilities driven by CBDC issuance.

Sources: US Federal Reserve, US Bureau of Economic Analysis, Macrobond, and Invesco, as of 28 February 2022. GFC = Global Financial Crisis. "Today" = 28 February 2022; "Pre-Pandemic" = February 2020; "Post-GFC" = December 2015; Pre-GFC" = December 2006.

Disclosures

Investment Risks

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