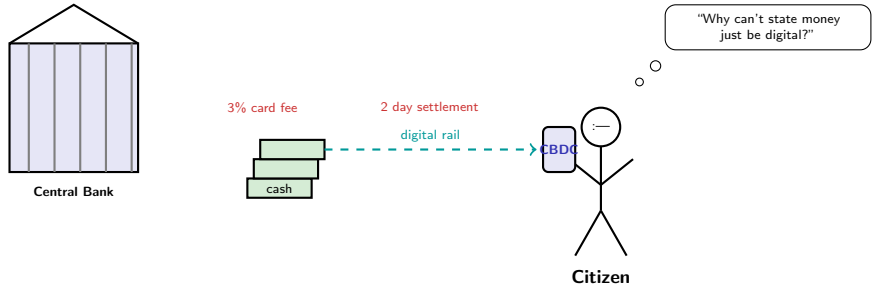
Central Bank Digital Currencies: Fundamentals

Lesson 08 — Emerging Topics

Digital Finance



Physical cash is a central-bank liability anyone can hold. Bank deposits are digital — but they are commercial liabilities. A CBDC would close the gap.

As cash fades, what replaces it: private tokens, bank deposits, or sovereign digital money?

What Problem Are Central Banks Actually Trying To Solve?

Paper money has worked for three centuries. Yet 130 of the world's 194 central banks are now researching or piloting a digital version of it. Why now?

CBDC (Central Bank Digital Currency): a digital form of central-bank money, available to the general public (retail) or to banks only (wholesale), representing a direct liability of the central bank rather than a commercial-bank deposit.

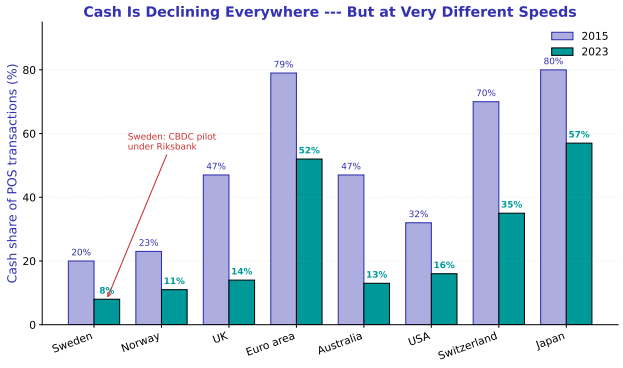
Four motivations — every CBDC project cites some mix of these:

- **Financial inclusion** — reaching 1.4 billion adults with no bank account (World Bank Findex 2021). A phone-based CBDC wallet does not require a bank to open.
- **Monetary sovereignty** — defending the domestic unit of account against private stablecoins and foreign CBDCs. The ECB's 2023 digital-euro report names this explicitly as a driver.
- **Payment efficiency** — instant settlement, lower fees, fewer intermediaries. Domestic RTGS already achieves most of this for banks; retail CBDC extends it to citizens.
- **Cash-decline response** — in Sweden, fewer than 10% of point-of-sale transactions use cash. If cash disappears, only commercial-bank money remains — and the public loses its risk-free payment option.

Different motivations produce different designs. A Bahamian CBDC targeting inclusion looks nothing like a Swedish CBDC protecting cash optionality.

CBDCs are not a technology in search of a problem. Each central bank has one or two dominant motivations that shape every design choice.

How Far Has Cash Already Declined In Daily Payments?



If cash keeps shrinking, a choice appears: accept that only private money remains, or issue a public digital alternative.

Key insights:

- **Sweden and Norway** lead the cash decline — under 12% of point-of-sale volume. Both central banks run active CBDC pilots.
- **Euro area and Japan** still see cash above 50% — but both have lost 20–25 percentage points since 2015.
- **Switzerland** fell from roughly 70% to 35% cash share in eight years, yet the SNB declares "no pressing need" for a retail CBDC.
- **The pattern:** fast-declining economies pilot CBDCs defensively; slow-declining economies do not feel the same urgency.

Cash decline is the single best predictor of CBDC research intensity — except in Switzerland.

Why Does Financial Inclusion Still Leave 1.4 Billion Behind?

Even in 2026, about 1.4 billion adults have no account at any bank, mobile-money provider, or credit union (World Bank Findex). Why does the account-based model leave so many behind?

Structural barriers:

- **Identity documents** — many unbanked lack formal ID, which banks require for KYC (Know-Your-Customer) compliance
- **Minimum balances and fees** — commercial banks cannot profitably serve accounts with average balances below USD 50–100
- **Physical distance** — rural areas without branches lose ATM and cash-in/out infrastructure
- **Trust deficit** — in countries with banking crises in living memory, people hold wealth as cash or gold rather than in banks

Why a retail CBDC changes the math:

- A CBDC wallet can be opened with a phone number and a simplified KYC tier (small balances, small transactions)
- Transaction marginal cost approaches zero — no card-network fees, no correspondent banking
- Central-bank backing eliminates counterparty risk, which matters in countries with weak deposit insurance
- Nigeria's eNaira (launched 2021) and The Bahamas' Sand Dollar (2020) explicitly targeted this population

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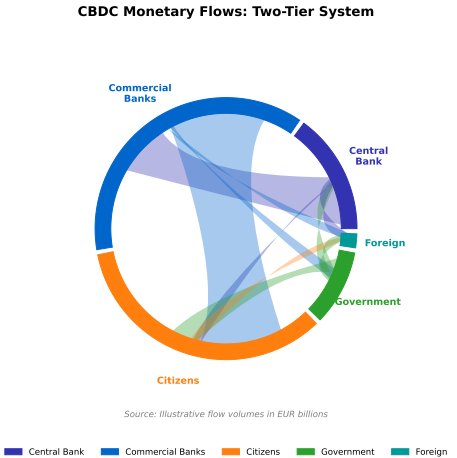
The inclusion case is strongest where commercial banks have demonstrably failed to scale — emerging markets, small island economies, and post-crisis economies.

What Is a CBDC, Really — And What Isn't?



A CBDC is:

- Issued by a central bank (not private)
- A direct central-bank liability (like cash)
- Denominated in the sovereign unit of account
- Legal tender where the law so provides

A CBDC is not:

- A stablecoin (private issuer, can default)
- A cryptocurrency (no central issuer, volatile)
- A commercial-bank deposit (requires bank trust)
- A tokenized version of existing bank money

The chord diagram shows how a retail CBDC sits in a two-tier monetary system: the central bank issues; commercial banks distribute; citizens hold; government settles tax flows.

A CBDC is a new category of money, not a digital skin on an old one. It is to cash what email was to letters.

Learning Objectives

By the end of this lesson, you will be able to:

1. **Explain** the four motivations (inclusion, sovereignty, efficiency, cash-decline response) that drive central banks toward CBDC experimentation
2. **Define** direct, two-tier, and synthetic CBDC architectures and identify the trade-off each makes between inclusion, privacy, and financial stability
3. **Describe** the global CBDC landscape across launched, pilot, development, and research phases with reference to specific country cases
4. **Analyse** the main risks a retail CBDC introduces — disintermediation, privacy erosion, cyber attack surface, and monetary-policy side effects

Direct, Two-Tier, or Synthetic — Who Holds the Wallet?

Before debating privacy or programmability, one question dominates every CBDC design: who actually holds the customer account? Throughout: *PSP* = Payment Service Provider (a licensed firm — bank or non-bank — that provides the wallet, KYC, and customer relationship on top of the central-bank ledger).

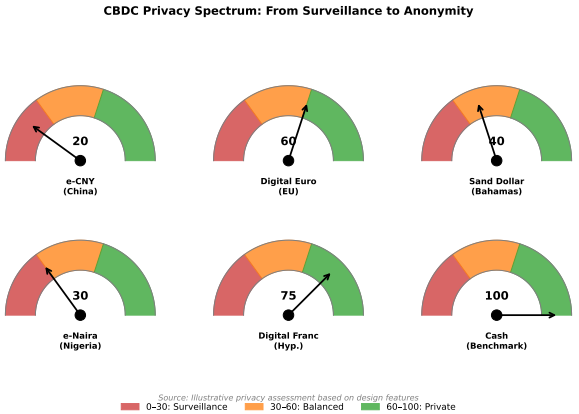
Dimension	Direct CBDC	Two-Tier CBDC	Synthetic CBDC (sCBDC)
Who issues?	Central bank	Central bank	Private regulated issuer
Who opens the wallet?	Central bank	Commercial bank or PSP	Private issuer (100% backed)
Who sees the transaction?	Central bank only	Bank + central bank (wholesale)	Issuer + central bank (backing)
Bank disintermediation	High (banks lose deposits)	Low (banks still central)	Low (banks or PSPs issue)
Central-bank operational load	Very high	Low	Low
Real-world examples	eNaira (Nigeria)	Digital Euro (proposed), e-CNY (China)	USDC-style backed stablecoins

Key observations:

- Every current pilot that has gone beyond 1 million users uses a two-tier design. Direct CBDC is a theoretical ideal that runs into operational reality.
- Synthetic CBDCs blur the line between CBDC and stablecoin — they are often regulated as the latter, not the former.
- The BIS 2023 survey of 86 central banks found 70% are building two-tier variants.

The architecture choice is a political choice dressed as a technical one — it determines who rents out the customer relationship.

Why Does Every Architecture Sacrifice Something?



Each design optimises for one goal and pays for it elsewhere.

Direct CBDC sacrifices banks. If every citizen holds central-bank money directly, commercial banks lose cheap deposit funding. Lending capacity shrinks.

Two-tier CBDC sacrifices inclusion purity. Banks still perform KYC, so the unbanked stay unbanked unless a simplified onboarding tier is carved out.

Synthetic CBDC sacrifices safety. The backing must be perfect — if any issuer's reserves fall below 100%, the "sovereign" quality evaporates.

The privacy dimension cuts across all three:

- e-CNY (China) scores low on privacy — tiered identity is mandatory
- Digital Euro proposes "cash-like" privacy below a threshold (EUR 150–300)
- Sand Dollar (Bahamas) applies tiered limits: anonymous up to USD 500

No single architecture wins on every axis. The design is a ranking of which trade-off each jurisdiction can live with.

Token-Based or Account-Based — Does the Data Model Matter?

Underneath the architecture debate sits a quieter engineering choice: how is CBDC ownership recorded?

Account-based CBDC:

- Ownership is a ledger entry tied to a verified identity
- Transfers debit and credit accounts
- KYC happens once at account opening
- Familiar to banks; easy to integrate with RTGS
- Examples: Digital Euro (proposed), most two-tier designs
- **Trade-off:** identity is always known; strong AML, weaker privacy

Token-based CBDC:

- Ownership is possession of a digital bearer instrument
- Transfers move the token itself (like cash)
- No account needed — any wallet can hold any token
- More cash-like; supports offline transactions
- Examples: eCash (DCEP pilot components), Project Tourbillon (SNB-BIS)
- **Trade-off:** closer to cash privacy; harder AML; risk of loss if key is lost

In practice most production pilots are hybrids: account-based at the bank layer, token-like at the citizen layer, with offline tokens as an add-on for cash-like use cases. Project Tourbillon (2022–2023) demonstrated that cryptographic blind signatures can give token-based CBDC near-cash privacy for the payer while still letting merchants be identified.

The token-vs-account choice is about which part of the stack holds the identity — not about whether identity is held at all.

How Much Privacy Should a Digital Coffee Deserve?

Theory: Privacy is not binary. Every CBDC design places each transaction somewhere on a spectrum from fully anonymous (cash) to fully transparent (audited corporate account).

Four anchor points on the spectrum:

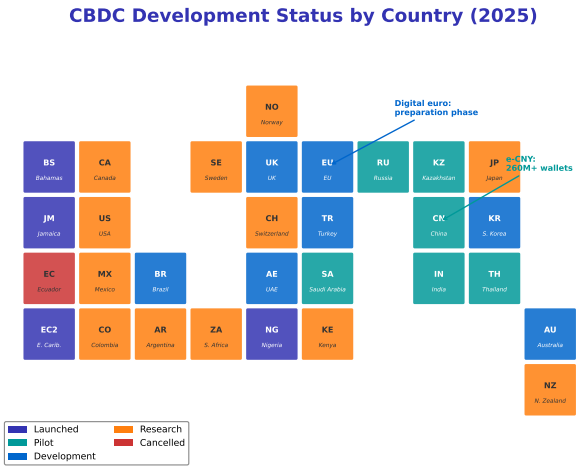
- **Fully anonymous (cash-like)** — no identity recorded, no ledger retention. Physical cash sits here.
- **Cash-like threshold** — below a stated limit (often EUR 150–300 or USD 500), the transaction is anonymous to the bank and central bank. Above the limit, standard AML applies. Digital Euro proposal sits here.
- **Pseudonymous with audit trail** — transactions visible to a regulated entity, not to the counterparty. Standard commercial banking sits here; so does most current two-tier CBDC planning.
- **Fully transparent** — every transaction is visible to the central bank. e-CNY's highest tier, large-value wholesale CBDC, and corporate tax-reporting wallets sit here.

Three unresolved design questions:

- Who sets the threshold, and can it be changed without legislation?
- Does offline CBDC get cash-like privacy regardless of amount?
- Can merchants be identified even when payers are not?

Privacy is a dial, not a switch. The legislation that sets the dial matters more than the technology that implements it.

Where Has a CBDC Already Launched — and How Fast Did People Adopt It?



As of 2026, the BIS tracks 130 countries in CBDC research. Four stages:

- **Launched:** The Bahamas (Sand Dollar, 2020), Jamaica (JAM-DEX, 2022), Nigeria (eNaira, 2021), Eastern Caribbean (DCash, 2021).
- **Pilot (widely distributed):** China (e-CNY — about 260 million wallets, 7 trillion yuan in transactions by 2024), India (Digital Rupee), Brazil (DREX).
- **Development:** Euro area (Digital Euro preparation phase to October 2025), UK, South Korea, Australia (wholesale).
- **Research:** USA, Japan, Switzerland.

Pattern: small economies with strong inclusion motive move fastest; large economies with deep existing payment rails move slowest. Launched CBDCs have not yet produced high retail adoption — Sand Dollar sits below 15% of adult wallets.

Launching a CBDC is comparatively easy. Making citizens actually use it is the hard part — no launched project has crossed 20% adoption after two years.

Why Is China's e-CNY Already Reaching 260 Million Wallets?

China began its DCEP (Digital Currency Electronic Payment) project in 2014. The e-CNY pilot has become the world's largest CBDC deployment.

Design choices that made scale possible:

- **Two-tier architecture** — six designated operators (ICBC, Bank of China, Construction Bank, Agricultural Bank, Bank of Communications, Postal Savings) distribute e-CNY. Central bank keeps the wholesale ledger only.
- **Tiered identity** — four wallet tiers from anonymous (up to CNY 2,000 per transaction) to fully identified corporate (unlimited). Privacy scales inversely with transaction size.
- **Dual offline** — sender and receiver can both be offline via NFC (Near-Field Communication) handshake.
- **Red-envelope promotions** — state lotteries distributed free e-CNY across cities to bootstrap adoption during 2021–2022.

Observed results (cumulative to 2024):

- About 260 million individual wallets opened
- Approximately 7 trillion yuan in cumulative transaction volume
- Merchant acceptance across 29 pilot cities including Beijing, Shanghai, Shenzhen
- Cross-border pilots through mBridge for wholesale settlement with HKMA, Bank of Thailand, UAE Central Bank

Open question: the volume is real, but active monthly users as a share of the Chinese population remain below Alipay/WeChat Pay — e-CNY competes against two private rails that already work.

China answers a question other jurisdictions are still asking: can a state roll out a CBDC at population scale? Yes — but displacing incumbents is harder than launching.

What Is the Digital Euro Actually Proposing?

The ECB moved from investigation phase (2021–2023) to preparation phase (November 2023–October 2025). No launch decision yet — but the proposal is detailed.

Digital Euro design (as of 2026 preparation phase):

- **Two-tier:** the ECB issues, commercial banks and PSPs distribute. Banks handle all KYC/AML.
- **Holding limit:** likely EUR 3,000 per resident wallet, to cap bank-run risk.
- **Privacy threshold:** offline transactions below approximately EUR 150–300 treated as cash-like (no transaction data visible to bank or ECB).
- **No interest paid** — the Digital Euro is a payment instrument, not a savings vehicle. This deliberately limits its appeal as a deposit substitute.
- **Merchant acceptance:** mandatory for most merchants that accept digital payments, once launched.
- **Programmability:** deliberately limited — no expiration dates, no category restrictions, no automatic tax deductions. Programmability of payments (e.g., conditional escrow) is separated from programmability of money.

Political constraints shaping the proposal:

- German and Austrian concerns over surveillance push toward strong privacy
- Commercial-bank lobby pushes for holding limit low enough to protect deposits
- GDPR sets a floor on data-protection design

The Digital Euro is not designed to change how Europeans pay — it is designed to preserve a public monetary anchor as cash fades.

Why Do Small Economies Lead the CBDC Race?

The first live CBDCs were not launched in Beijing, Frankfurt, or Washington. They were launched in Nassau, Kingston, Basseterre, and Abuja.

Country	CBDC	Launched	Driving motivation
The Bahamas	Sand Dollar	Oct 2020	Geographic inclusion (hurricanes, remote islands)
Eastern Caribbean	DCash	Mar 2021	Cross-island interoperability, remittances
Nigeria	eNaira	Oct 2021	Large unbanked population (approx 40%)
Jamaica	JAM-DEX	Jul 2022	Cash dependence, remittance costs (8%+)

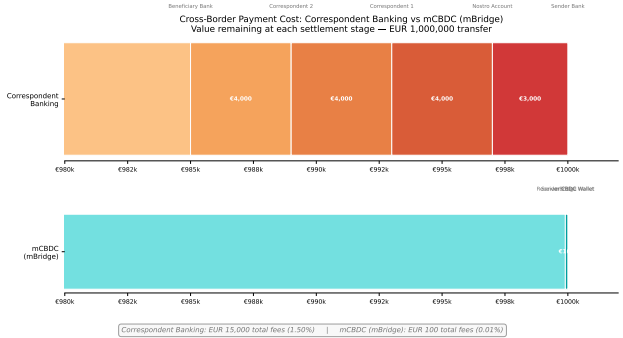
Why small economies move first:

- Smaller populations mean smaller operational scale — a central bank can actually run the infrastructure
- Single regulatory perimeter, single language, single legal system simplify rollout
- Less entrenched commercial payment rail means less displacement cost
- Inclusion benefit per CBDC wallet is largest where alternatives are weakest

What small economies teach large ones: adoption is slow even when the infrastructure is live. Sand Dollar reached roughly 15% adult adoption after three years. eNaira sits below 1% of active use. The technology works; user behaviour is the bottleneck.

Small-economy CBDCs are the laboratory. Large-economy CBDCs will inherit both the lessons and the adoption disappointments.

Can mBridge and Agora Make Cross-Border Settlement Cheap?



Cross-border payments remain the slowest and costliest segment of the payment stack. Two BIS-hosted projects test whether CBDC rails change that.

mBridge (Multiple CBDC Bridge):

- Partners: HKMA, Bank of Thailand, PBoC Digital Currency Institute, UAE Central Bank, plus BIS Innovation Hub Hong Kong
- Platform completed pilot in 2022; handles wholesale CBDC settlement in seconds, not days
- Observed cost-per-transfer near 1 basis point vs. 3–7% via correspondent banking

Project Agora:

- Partners: Bank of France (Eurosystem), FED of New York, BoE, BoJ, Bank of Korea, Bank of Mexico, SNB
- Focus: tokenised wholesale CBDC plus tokenised commercial-bank money on a unified ledger
- Explores cross-currency atomic settlement (no Herstatt risk)

Political barrier: the US Treasury has raised sanctions-evasion concerns about mBridge, so the two projects operate on partly non-overlapping country sets.

CBDC cross-border rails are technically ready. The bottleneck is political — which countries will share a ledger.

Will a CBDC Trigger the World's First Digital Bank Run?

Silicon Valley Bank lost 25% of its deposits in one day in March 2023 — via smartphone transfers to other banks, during business hours. A CBDC could amplify that pattern.

How a CBDC bank run would differ from historical runs:

- **Speed:** transfer from bank deposit to CBDC wallet takes seconds, not a queue at a branch. Northern Rock queues formed over days in 2007; SVB lost deposits in hours.
- **No liquidity cap:** unlike ATM withdrawals (physically limited by cash in the machine), CBDC outflows are limited only by the ledger.
- **Reflexivity:** social media accelerates panic. A rumour on Twitter at 9am could drain a mid-sized bank by 5pm.
- **Cross-border amplification:** if foreign CBDCs are accessible domestically, the run can leave the currency area entirely.

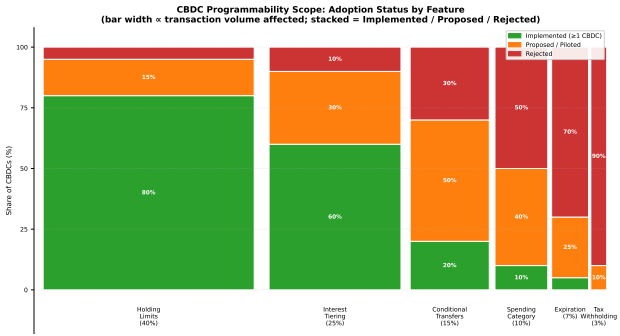
Design responses being tested:

- **Holding limits** — Digital Euro's proposed EUR 3,000 cap per wallet
- **Tiered remuneration** — zero or negative interest on CBDC balances above the cap
- **Throttling** — daily conversion limits from bank deposits to CBDC
- **Emergency switch** — central-bank authority to pause CBDC-to-cash conversion in a crisis

The design dilemma: every safeguard that prevents runs also limits CBDC usefulness. A cap that prevents bank runs also prevents merchants from holding large working balances in CBDC.

The fear is not that a CBDC causes a bank run — the fear is that it makes bank runs frictionless, so they happen more often.

How Much Can Programmable Money Actually Be Programmed?



"Programmable money" means different things to different actors — and the design choices reveal priorities.

Widely implemented:

- Holding limits (about 80% of active pilots)
- Interest tiering (60%)

Proposed but not common:

- Conditional transfers (escrow, milestone payments)
- Spending categories (stimulus restricted to specific sectors)

Mostly rejected:

- Expiration dates on money
- Automatic tax withholding at the wallet level

Key distinction: programmability *of payments* (escrow, conditional logic built on top of CBDC) is widely accepted. Programmability *of the money itself* (expiration, automatic deductions) is widely rejected in democratic jurisdictions because it erodes the legal-tender property.

The programmability debate separates the rails from the money. Smart contracts on CBDC rails are welcome. Smart contracts that change what one euro can do are not.

What Cyber Threats Are Unique to Sovereign Digital Money?

A commercial bank's core system going down is a bad day. A central bank's CBDC ledger going down is a sovereignty event.

Threats a CBDC inherits from any digital system:

- Distributed denial-of-service (DDoS) on wallet infrastructure
- Credential theft and social engineering against users
- Insider attacks against operators
- Supply-chain vulnerabilities in hardware security modules

Threats that are specific to CBDC:

- **Ledger compromise** — a successful attack on the central-bank ledger is a direct attack on the money supply
- **Post-quantum cryptography** — today's CBDC signatures will eventually be breakable by quantum computers; migration paths must be built in from day one
- **Mass offline double-spend** — token-based offline CBDC must prevent a single compromised device from minting unlimited copies
- **Geopolitical targeting** — state-level adversaries may target a rival's CBDC as strategic infrastructure, like GPS or electricity grid

Resilience design pattern: keep a cash system running in parallel. If the CBDC ledger fails, citizens must still have a fallback. Sweden's Riksbank explicitly kept cash-distribution law in force as a precondition for any e-krona launch.

A CBDC is critical national infrastructure from day one. The design must assume the ledger will, at some point, be attacked.

Does a CBDC Weaken or Strengthen Monetary Policy?

A retail CBDC creates new policy tools and new policy problems. Both sides of the argument use plausible economics.

Why a CBDC strengthens policy transmission:

- **Direct channel** — policy rates can pass through to citizen balances without going through bank lending spreads
- **Targeted stimulus** — helicopter money can be distributed to specific demographics or regions
- **Real-time data** — aggregate consumption data becomes available in days, not quarterly lags
- **Lower effective lower bound** — negative rates become enforceable because there is no bank-deposit alternative with zero rate

Why a CBDC weakens policy transmission:

- **Bank intermediation shock** — if banks lose deposits, lending capacity shrinks and rate cuts bite less
- **Cross-border leakage** — if foreign CBDCs circulate domestically, domestic rate policy loses traction
- **Political constraint** — using programmable money for unpopular policy (negative rates, spending restrictions) triggers political backlash
- **Currency substitution** — weaker currencies may see citizens flee to a dominant foreign CBDC (digital dollar, digital yuan)

The BIS has documented these arguments at length in its annual reports since 2020 without picking a winner. The reality is that the effect depends on the design: a two-tier CBDC with holding limits weakens transmission much less than a direct CBDC with no cap.

A CBDC is a power amplifier for whatever monetary-policy stance the central bank holds. In a rate-hike cycle that cuts both ways.

Will CBDCs Compete With Stablecoins, or Coexist?

Private stablecoins already solve several problems a CBDC would solve. The market is running ahead of central banks.

Dimension	Regulated stablecoin (e.g. USDC, EUROe)	Retail CBDC (e.g. Digital Euro)
Issuer	Private, regulated (MiCA, NY DFS)	Central bank
Backing	1:1 reserves in government debt or CB deposits	Direct central-bank liability (no backing needed)
Default risk	Non-zero (issuer can fail)	Zero (sovereign)
Innovation speed	Fast — smart contracts, DeFi composability	Slow — regulatory and political process
Geographic reach	Global by default	Typically single-jurisdiction
Typical volume (2025)	USD 250+ billion stablecoin market cap	Under USD 1 billion in launched CBDCs

Three coexistence scenarios:

- **CBDC as anchor:** Central bank issues retail CBDC; regulated stablecoins settle through CBDC rails. This is the ECB's preferred model.
- **CBDC as wholesale only:** Retail layer is private (stablecoins, bank money). Central bank only issues wholesale CBDC. Switzerland's current direction.
- **CBDC displaces stablecoins:** Regulation restricts stablecoin issuance; retail CBDC takes its place. China's direction for domestic use.

CBDCs and stablecoins can coexist — if regulators decide what the base money is and what sits on top of it.

Where Will the Next Five Years Actually Land?

Forecasting CBDC adoption is forecasting political decisions, not technology readiness. The technology mostly works; the decisions do not yet.

Likely developments by 2031:

- **Wholesale CBDC becomes routine.** Every G20 central bank will likely run a production wholesale CBDC for interbank settlement by 2030. Project Agora and mBridge scale up. This is the uncontroversial path.
- **Retail CBDC launches in one or two major economies.** Digital Euro decision point comes in late 2025 or 2026. If launched, production follows by 2028. UK follows within 18 months.
- **Cross-border CBDC corridors go live.** Five to ten bilateral or multilateral corridors handle meaningful wholesale flows.
- **Sand Dollar, eNaira, JAM-DEX plateau.** No breakthrough in retail adoption without massive merchant-side incentive.
- **USA remains out.** Political resistance blocks a retail digital dollar. Wholesale variants via FedNow-plus continue quietly.

What would change the forecast:

- A mass-adoption stablecoin failure that triggers systemic disruption — accelerates CBDC
- A geopolitical shock that splits payment rails along political lines — accelerates CBDC
- A privacy scandal inside a launched CBDC — decelerates CBDC everywhere

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The next five years will answer whether retail CBDC is inevitable or avoidable — not whether it is technically possible.

Why Does Switzerland Say 'No Pressing Need'?

Switzerland sits in an unusual position: high wealth, high digital penetration, declining cash share, strong payment rail, and an SNB that publicly says a retail CBDC is not necessary.

Why the SNB is conservative on retail CBDC:

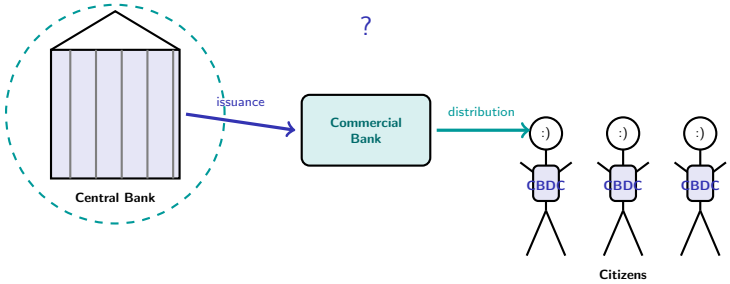
- **TWINT already works** — the domestic mobile payment app settles via SIC and has over 5 million active users
- **Cash remains available** — the SNB has committed to maintaining cash distribution as long as demand exists
- **Financial inclusion is not the bottleneck** — Swiss banking access is near-universal
- **Privacy tradition** — Swiss banking secrecy culture makes the surveillance side of CBDC politically toxic
- **Small economy, large spillover** — a Swiss CBDC adds marginal benefit domestically but could destabilise smaller currency areas if it becomes attractive as a reserve

Where Switzerland is active:

- **Wholesale CBDC** — Project Helvetia (phases I, II, III with BIS-IH, SIX, and commercial banks) has demonstrated production-grade wholesale CBDC settlement. The SNB has since launched a live pilot.
- **Project Tourbillon** — BIS-IH-SNB research on privacy-preserving CBDC architectures
- **Project Agora** — cross-border tokenised settlement with six other central banks

Strategic pattern: Switzerland leads on wholesale CBDC research and declines retail CBDC — a deliberate asymmetry that preserves bank and payment innovation space while securing interbank infrastructure.

Switzerland's "no pressing need" is not technological conservatism. It is a considered policy stance that matches the country's structure.



The question is no longer whether digital state money is possible. It is which design — and which trade-offs — a society can live with.

A CBDC is less a technology choice than a constitutional one — who sees, who controls, who pays.

Summary

Key takeaways from the CBDC fundamentals lesson:

1. **Four motivations drive every CBDC project:** financial inclusion for the 1.4 billion unbanked, monetary sovereignty against private stablecoins and foreign CBDCs, payment efficiency through instant settlement, and a public response to the decline of physical cash. Different jurisdictions weight these differently.
2. **Three architectures make different trade-offs:** direct CBDC maximises inclusion but disintermediates banks; two-tier CBDC preserves banking but depends on private KYC; synthetic CBDC delegates to regulated issuers but reintroduces counterparty risk. Most current pilots are two-tier.
3. **The global landscape is uneven:** The Bahamas, Jamaica, Nigeria and the Eastern Caribbean have launched; China pilots e-CNY across 260 million wallets; the Digital Euro is in preparation phase with a 2026 launch decision; Switzerland leads on wholesale but declines retail.
4. **The main risks are systemic, not technical:** digital bank runs, privacy erosion, cyber attack on critical infrastructure, and a weakening of monetary-policy transmission. Design safeguards — holding limits, tiered privacy, offline fallback — exist but each costs something.

Next lesson: how CBDCs integrate with the broader Lesson 08 emerging-topics stack — DeFi, GenAI, climate risk, and quantum finance.