CBDCs: Money Reimagined — Central Banks in the Digital Age

Module 6: The Infrastructure Problem

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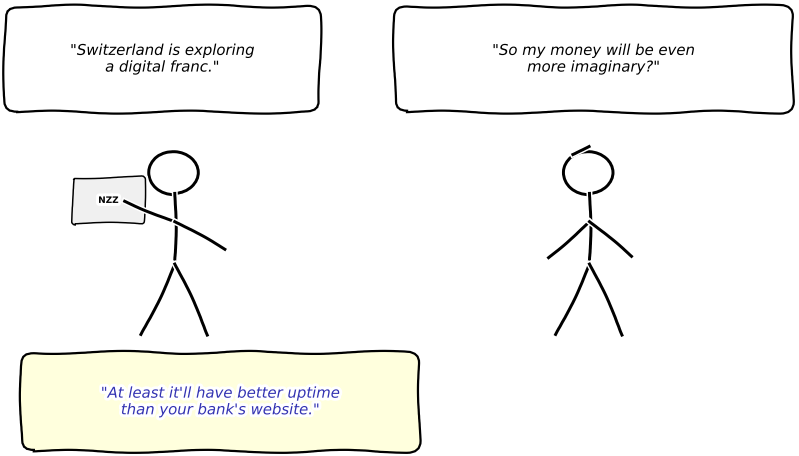
Digital Finance — BSc Course

Standalone lecture — examines whether central banks should issue digital currency directly to the public.

Digital Francs



Switzerland's SNB is exploring wholesale CBDCs (Central Bank Digital Currencies) — but not yet retail.

Learning Objectives

After completing this lecture, you will be able to:

1. **Define** what a CBDC is and how it differs from existing digital money [Understand]
2. **Explain** the BIS Money Flower taxonomy and its four dimensions [Understand]
3. **Compare** global CBDC approaches (China, ECB, Switzerland, US) [Analyze]
4. **Evaluate** the risks of CBDCs: disintermediation, privacy, financial stability [Evaluate]
5. **Assess** Switzerland's strategic position through Project Helvetia and Tourbillon [Evaluate]

Bloom's levels covered: Understand, Analyze, Evaluate

Objectives follow Bloom's taxonomy: Understand → Analyze → Evaluate.

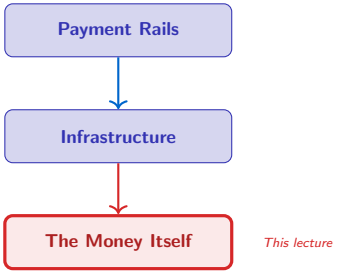
Bridge: From Payment Rails to Central Bank Money

Module 6, Lesson 1 taught us:

- Payment rails (the network of systems that move money between banks and users) are invisible infrastructure
- RTGS (Real-Time Gross Settlement), SWIFT, and ACH (Automated Clearing House) move trillions daily
- Settlement (the final transfer of funds between parties) takes 1–3 days for most transactions

This lecture asks a different question:

What if the money itself changes?



M6L1 covered how money moves; this lecture covers what happens when central banks reimagine money itself.

Central Question

Should central banks compete with commercial banks

to put money directly in your phone?

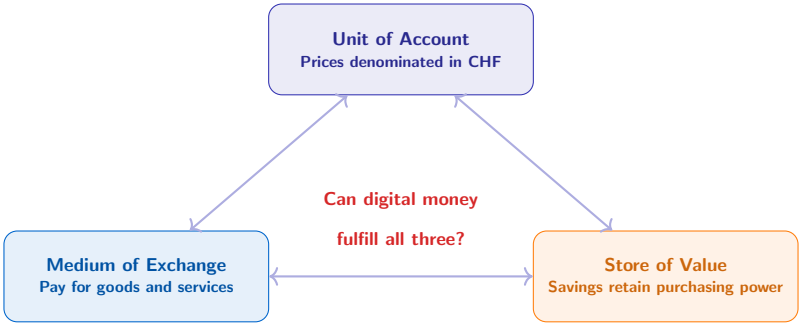
Today: Central bank → Commercial bank → You

CBDC: Central bank → **You (directly?)**

This question touches monetary policy, banking, privacy, and technology — all at once.

A CBDC (Central Bank Digital Currency) is digital money issued by a central bank for use by the general public or financial institutions.

Three Functions of Money

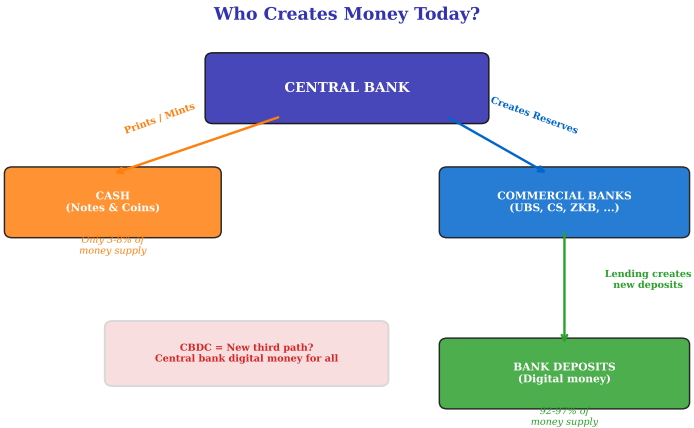


Definition: Money

Anything widely accepted as payment for goods/services and repayment of debts. Must serve as unit of account, medium of exchange, and store of value.

Any CBDC must fulfill all three functions — most cryptocurrencies fail on "store of value" due to volatility.

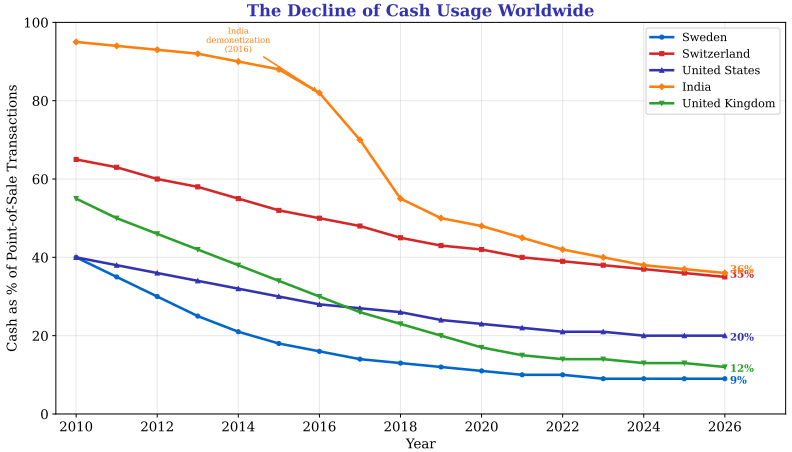
Who Creates Money Today?



What you see: Two paths — central bank (cash/reserves) vs. commercial banks (deposits via lending). **Key pattern:** 92–97% of money is created by commercial banks, not central banks. **Takeaway:** CBDC = a third path — digital central bank money for the public.

Commercial banks create money through fractional reserve lending — each loan creates a new deposit.

Cash Is Disappearing



What you see: Cash usage trends across five countries from 2010 to 2026. **Key pattern:** Sweden at 9%; Switzerland at 35% — relatively high for Europe. **Takeaway:** As cash vanishes, central banks lose their direct link to citizens — CBDCs could restore it.

Sweden's Riksbank was among the first to explore a CBDC (e-krona) precisely because cash usage dropped below 10%.

The Digital Money Landscape

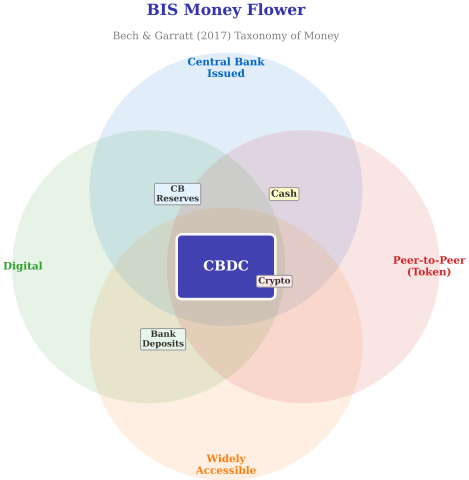
Digital Money Landscape

	Cash	Bank Deposits	Mobile Money	Crypto	Stablecoins	CBDC
Issuer	Central Bank	Commercial Bank	Telecom / FinTech	None (Protocol)	Private Company	**Central Bank**
Technology	Physical	Ledger (Database)	Mobile Ledger	Blockchain	Blockchain	**Varies (DLT/DB)**
Regulation	Full	Full	Partial	Minimal	Emerging	**Full**
Volatility	None	None	None	Very High	Low-Med	**None**
Access	Universal	Bank Account	Phone Owner	Anyone (Wallet)	Anyone (Wallet)	**Design Choice**

What you see: Six forms of money compared on issuer, technology, regulation, volatility, and access. **Key pattern:** CBDCs combine the regulation of cash with the digital nature of crypto. **Takeaway:** CBDCs fill a unique gap — central-bank-issued, digital, regulated, zero volatility.

Stablecoins (crypto tokens pegged to fiat currencies like the US dollar) are private-sector competitors to CBDCs.

BIS Money Flower: Classifying Money



What you see: Four circles — central bank issued, digital, widely accessible, token-based. **Key pattern:** CBDC sits at the intersection of all four — no existing money form does this. **Takeaway:** The Bech & Garratt (2017) BIS taxonomy shows CBDCs are genuinely novel.

Retail vs Wholesale CBDCs

Retail CBDC

Users: General public

Purpose: Day-to-day payments

Examples: e-CNY, Sand Dollar, Digital Euro

Challenge: Competes with bank deposits, raises disintermediation risk

Scale: Millions of users, millions of transactions per second

Wholesale CBDC

Users: Banks and financial institutions

Purpose: Interbank settlement, securities

Examples: Project Helvetia, mBridge

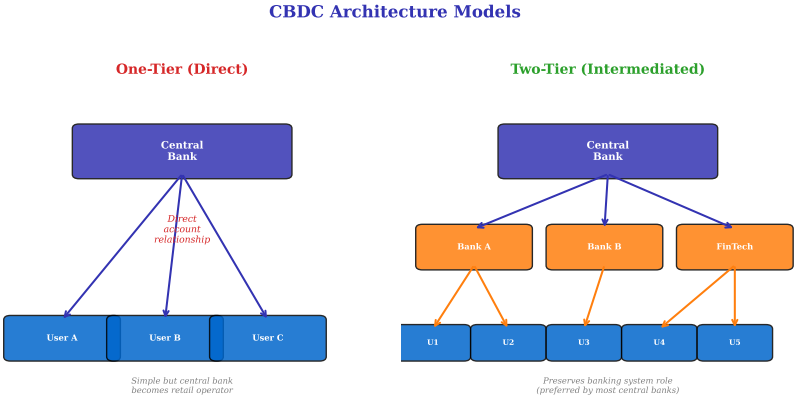
Challenge: Limited to institutional use, less visible impact

Scale: Hundreds of participants, large-value transactions

Switzerland's SNB focuses on wholesale — leaving retail payments to the private sector.

Retail = for everyday people. Wholesale = for banks and institutions. Most central banks explore both, but priorities differ.

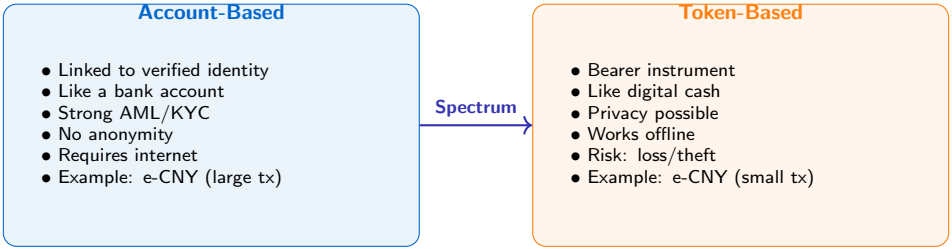
Architecture: One-Tier vs Two-Tier



What you see: One-tier (CB serves public directly) vs. two-tier (CB works through intermediaries). **Key pattern:** Nearly every CBDC project has chosen two-tier. **Takeaway:** Two-tier preserves commercial banks' role while giving the CB a digital presence.

One-tier means the central bank handles KYC (Know Your Customer), tech support, and fraud — an operational burden few want.

Account-Based vs Token-Based

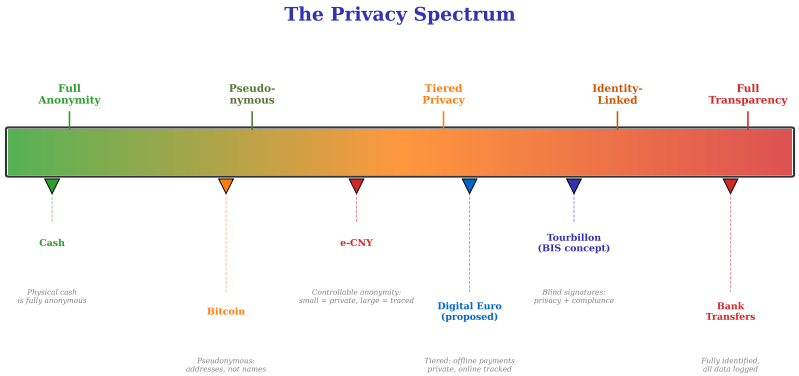


Definition: Bearer Instrument

A financial instrument where whoever holds ("bears") it owns it — like a banknote. No identity verification needed for transfer.

Most CBDC designs use a hybrid: account-based for large transactions, token-based for small everyday payments.

The Privacy Spectrum



Central bank design choice: privacy vs AML/KYC enforcement

What you see: A gradient from full anonymity (cash) to full transparency (bank transfers), with CBDCs positioned along it. **Key pattern:** No CBDC achieves cash-level anonymity — all involve traceability for AML/KYC. **Takeaway:** Privacy design is the most politically sensitive CBDC decision.

AML = Anti-Money Laundering. KYC = Know Your Customer. Both are regulatory requirements to prevent financial crime.

Programmable Money — Promise and Peril

Promising Applications

- **Targeted subsidies:** Government payments that can only be spent on food, rent, or education
- **Conditional transfers:** Disaster relief released automatically when conditions are met
- **Tax automation:** VAT collected at point of sale, instantly
- **Expiry dates:** Stimulus money that must be spent within 90 days (used in e-CNY pilot)

Concerning Implications

- **Social control:** Government decides what you can buy
- **Surveillance:** Every transaction visible to authorities
- **Discrimination:** Restrictions applied to specific groups
- **Censorship:** Dissidents' money "turned off"
- **Mission creep:** Temporary restrictions become permanent

Definition: Programmable Money

Digital currency with built-in rules that control when, where, or how it can be spent — enforced by code, not by trust.

The ECB explicitly promises the Digital Euro will NOT be programmable — distinguishing "programmable payments" from "programmable money."

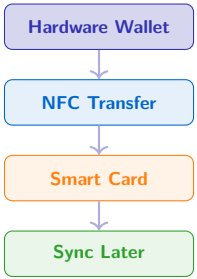
Offline Capability: When the Internet Is Down

Why offline matters:

- Natural disasters disrupt connectivity
- Rural areas lack reliable internet
- Financial inclusion requires access without smartphones
- Cash works everywhere — a CBDC must compete

Technical approaches:

1. **Hardware wallets:** Secure chips storing value locally
2. **NFC (Near-Field Communication):** Tap-to-pay between devices
3. **Smart cards:** Prepaid cards with embedded secure elements
4. **Delayed settlement:** Transactions sync when reconnected



Challenge: Preventing double-spending offline requires cryptographic safeguards.

NFC = Near-Field Communication, the technology behind contactless payments (Apple Pay, Google Pay, Swiss TWINT tap-to-pay).

Think-Pair-Share

Discussion Question:

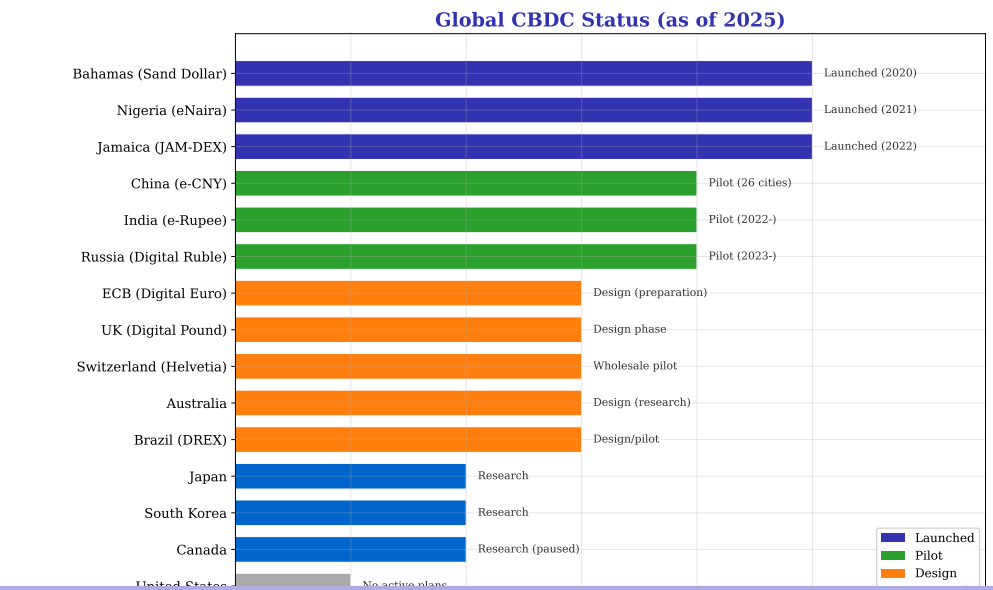
"Would you accept a CBDC that logs all your transactions for anti-money-laundering purposes?"

Consider:

- Your bank already sees all your digital transactions — is a CBDC different?
- Would you accept logging if small transactions (under CHF 200) stayed private?
- Does your answer change depending on *which* government operates the CBDC?

Think individually (1 min), discuss with a partner (2 min), share with the class (3 min).

130+ Countries Exploring CBDCs



e-CNY: The World's Largest CBDC Pilot

Key statistics (as of late 2024):

- 260 million+ individual wallets opened
- 180 billion+ yuan (CHF 22B+) cumulative transactions
- 26 pilot cities across China
- Used for transit, retail, government payments
- Integrated into Alipay and WeChat Pay

Motivation:

- Counter Alipay/WeChat duopoly (combined 90%+ of mobile payments)
- Maintain monetary sovereignty (the central bank's ability to control its own currency)
- Potential for cross-border use (mBridge)

260M+ wallets

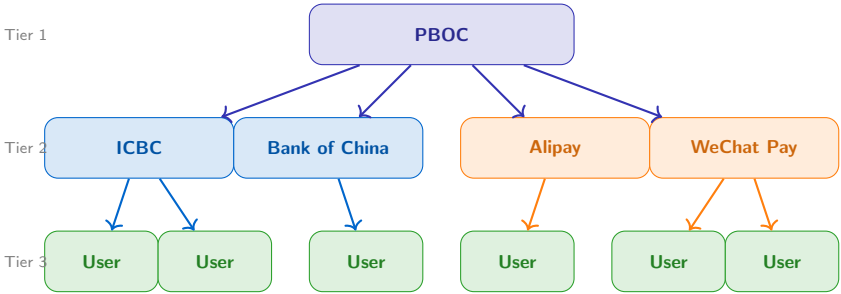
26 pilot cities

180B+ yuan volume

2020 pilot start

The e-CNY is a two-tier retail CBDC: PBOC (People's Bank of China) issues it, but commercial banks and payment platforms distribute it.

e-CNY: How It Works



Two-tier model: PBOC issues e-CNY to authorized operators (banks + payment platforms), who distribute to end users. PBOC never directly interacts with the 260M+ wallet holders.

"Controllable anonymity" means small transactions are anonymous, but large ones are traceable — a tiered privacy approach.

e-CNY: Lessons Learned

What Worked

- Integration with existing apps (Alipay, WeChat) lowered adoption barriers
- Government subsidies via e-CNY "red packets" drove initial usage
- Offline capability tested (NFC hardware wallets)
- Cross-border potential via mBridge

Adoption Challenge

- Users ask: "Why switch from Alipay?" — no compelling consumer benefit
- Transaction volumes remain tiny vs. Alipay/WeChat (less than 0.2%)
- Merchants see no advantage over existing payment rails
- "Solution looking for a problem" criticism

Key Lesson

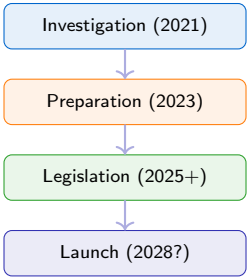
Technology alone does not drive adoption. A CBDC must offer something users cannot get from existing payment systems — or be mandated.

The e-CNY's main strategic value may be geopolitical (cross-border) rather than domestic consumer payments.

Digital Euro: Privacy by Design

ECB's (European Central Bank) design principles:

- **Privacy first:** Offline payments with cash-like anonymity for small amounts
- **Holding limits:** Proposed cap of EUR 3,000 per person
- **Two-tier:** ECB issues, banks and PSPs (Payment Service Providers) distribute
- **No interest:** Prevents it from competing with savings accounts
- **Complementary:** Designed to coexist with cash, not replace it



Timeline:

- 2021–2023: Investigation phase
- 2023–2025: Preparation phase
- 2025+: Legislative process, potential launch 2028–2029

PSP = Payment Service Provider (e.g., Adyen, Stripe, SIX). The Digital Euro would be legal tender in all eurozone countries.

Digital Euro: Design Choices

Design Dimension	ECB Choice	Rationale
Architecture	Two-tier (ECB + banks)	Preserve banking system
Access	Account-based + offline token	Privacy + compliance
Holding limit	EUR 3,000 (proposed)	Limit bank disintermediation
Interest	Zero (no remuneration)	Not a savings instrument
Privacy	"Cash-like" for offline	Public demand, GDPR (General Data Protection Regulation)
Programmability	Payments yes, money no	Avoid "Big Brother" concerns
Offline	Yes (hardware wallets)	Financial inclusion

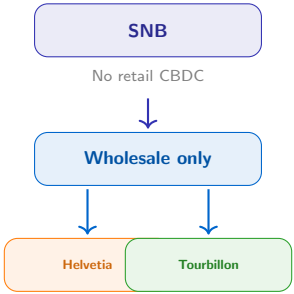
Key distinction: The ECB separates "programmable payments" (automatic bill pay) from "programmable money" (restrictions on spending). Only the former is planned.

GDPR = General Data Protection Regulation, the EU's privacy law. The Digital Euro must comply with its strict data protection rules.

Swiss Focus: SNB and CBDCs

Switzerland's position:

- **No retail CBDC planned:** SNB (Swiss National Bank) sees no need — Swiss payment infrastructure works well
- **Wholesale focus:** Exploring CBDC for interbank settlement and securities (financial assets like stocks, bonds, or derivatives)
- **Two major projects:**
  - Project Helvetia (with SIX) — Helvetia III live pilot: ongoing 2025 (*SNB Financial Stability Report*, 2024–2025)
  - Project Tourbillon (with BIS Innovation Hub)
  - Project Agorá (cross-border wholesale, 7 central banks + BIS) — Project Agorá (*BIS Project Agorá public documentation*, 2024+)
- **Cash commitment:** SNB guarantees continued cash availability



Why wholesale, not retail?
Switzerland has TWINT, SIC (Swiss Interbank Clearing), and high banking penetration — retail CBDC adds little consumer benefit.

SNB = Swiss National Bank. SIC = Swiss Interbank Clearing. SDX = SIX Digital Exchange (Switzerland's regulated DLT-based exchange).

Project Helvetia: Wholesale CBDC on SDX

A collaboration between SNB, BIS Innovation Hub, and SIX.

Phase I (2020)

Proof of concept

Settled tokenized assets using wholesale CBDC on a test DLT (Distributed Ledger Technology) platform.

Result: Technically feasible.

Phase II (2022)

Integration test

Connected wholesale CBDC to existing SIC payment system and SDX.

Result: Integration with legacy systems works.

Phase III (2024)

Live pilot

Real wholesale CBDC transactions on SDX with actual Swiss franc settlement.

Result: First live wholesale CBDC in a major financial center.

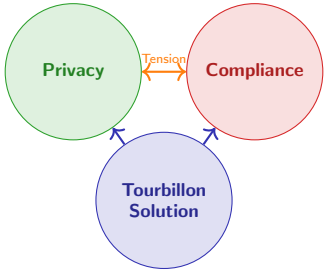
Significance: Switzerland is the first major financial center to conduct live wholesale CBDC transactions on a regulated exchange.

DLT = Distributed Ledger Technology (the technology family that includes blockchains). SDX uses Corda, not a public blockchain.

Project Tourbillon: Privacy Meets Compliance

BIS Innovation Hub Basel project:

- **Goal:** Prove that CBDCs can have cash-like privacy *and* regulatory compliance
- **Key technology:** Blind signatures (a cryptographic technique where the signer signs a message without seeing its content)
- **How it works:**
  1. Central bank signs tokens without seeing who holds them
  2. Users transact privately (like cash)
  3. AML limits enforced by the system, not by surveillance
- **Result:** Privacy and compliance are not mutually exclusive



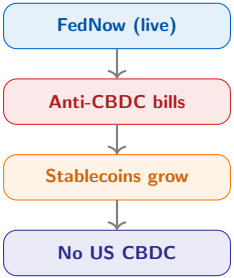
Blind signatures resolve the privacy–compliance tension.

Named after the tourbillon mechanism in Swiss watchmaking — an elegant solution to a fundamental problem (gravity in watches, privacy in CBDCs).

The US Exception: No CBDC (For Now)

Why the US stands apart:

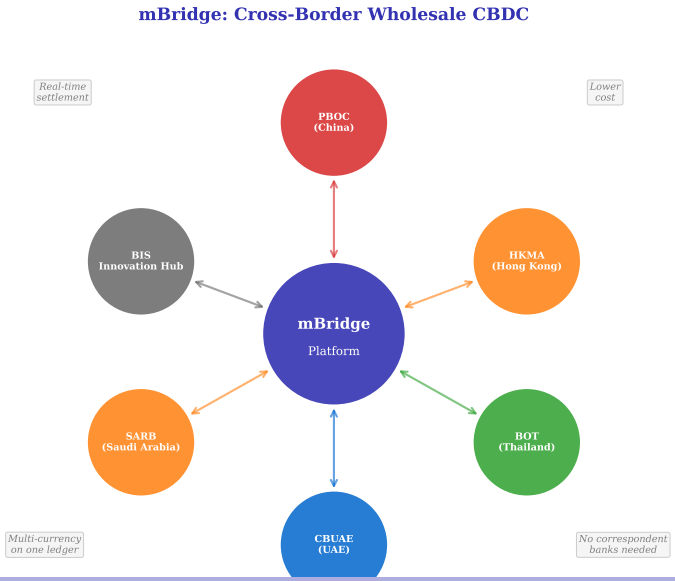
- **FedNow (2023):** Real-time payment system launched — addresses speed without needing CBDC
- **Political opposition:** "CBDC Anti-Surveillance State Act" introduced in Congress
- **Privacy concerns:** Strong libertarian tradition resists government visibility into transactions
- **Dollar dominance:** USD is already the global reserve currency — less urgency to innovate
- **Stablecoin preference:** Private-sector stablecoins (USDC, USDT) fill the digital dollar gap



Irony: The country whose currency dominates global finance is the least interested in a CBDC.

FedNow enables instant bank-to-bank payments 24/7 — solving the speed problem without creating central bank digital money.

Cross-Border: The mBridge Platform



Risk 1: Bank Disintermediation

Definition: Disintermediation

When customers bypass banks by moving money directly to the central bank via CBDC — reducing banks' ability to fund loans.

This is the single biggest concern about retail CBDCs — if deposits leave banks, the entire credit creation mechanism weakens.

Worked Example: Swiss Disintermediation Scenario

Scenario: What If 20% of Swiss Deposits Move to CBDC?

Swiss banking deposits (2024): approximately CHF 2,000 billion

If 20% moves to CBDC: CHF 400 billion leaves the banking system

Impact on banks:

1. Banks lose CHF 400B in cheap deposit funding
2. Must replace with wholesale funding (bonds, interbank lending) — more expensive
3. Cost increase passed to borrowers
4. **Estimated mortgage rate increase: +50 to +100 basis points (bps)**

For a CHF 800,000 mortgage at 2.0%:
Current annual cost: CHF 16,000
With +75 bps: CHF 22,000 → **+CHF 6,000/year**

This is why the ECB proposes a EUR 3,000 holding limit — to prevent mass deposit flight.

1 basis point (bp) = 0.01%. So +75 bps = +0.75 percentage points. Swiss mortgage rates were around 2% in 2024.

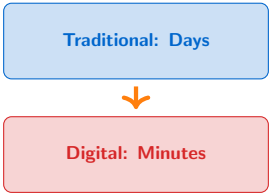
Risk 2: Digital Bank Runs

Traditional bank run:

- People queue at branches
- Physical cash limits withdrawal speed
- Takes days to escalate
- Central bank has time to intervene

CBDC-enabled digital run:

- One tap: move all deposits to CBDC
- No physical constraint on speed
- Could drain a bank in **minutes**
- Contagion spreads via social media



Credit Suisse (2023): Deposits fled at unprecedented speed via mobile banking — a CBDC would have accelerated this further.

The Credit Suisse collapse in March 2023 saw CHF 10B+ in daily deposit outflows — imagine if CBDC made this frictionless.

Risk 3: Privacy and Surveillance

Surveillance Risks

- Government sees every transaction
- Spending patterns reveal political views, health, relationships
- Authoritarian regimes could freeze accounts of dissidents
- "If you have nothing to hide" argument fails: everyone has something private
- Chilling effect on lawful behavior

Mitigation Strategies

- **Tiered privacy:** Small transactions private, large ones reported
- **Blind signatures:** Central bank signs without seeing content (Project Tourbillon)
- **Zero-knowledge proofs:** Prove compliance without revealing details
- **Legal safeguards:** GDPR, constitutional protections
- **Offline mode:** Cash-like anonymity for small amounts

The fundamental tension: Governments want visibility for law enforcement; citizens want privacy for personal freedom. Every CBDC design navigates this trade-off.

Zero-knowledge proof = a cryptographic method to prove a statement is true without revealing the underlying data (e.g., "I am over 18" without showing age).

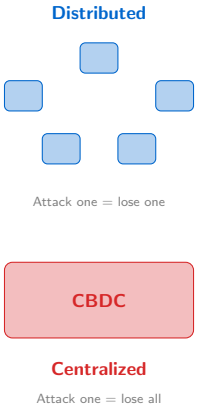
Risk 4: Cybersecurity and Single Points of Failure

Today's distributed risk:

- Thousands of independent banks
- Hack one bank $\neq$ hack the system
- No single point of failure

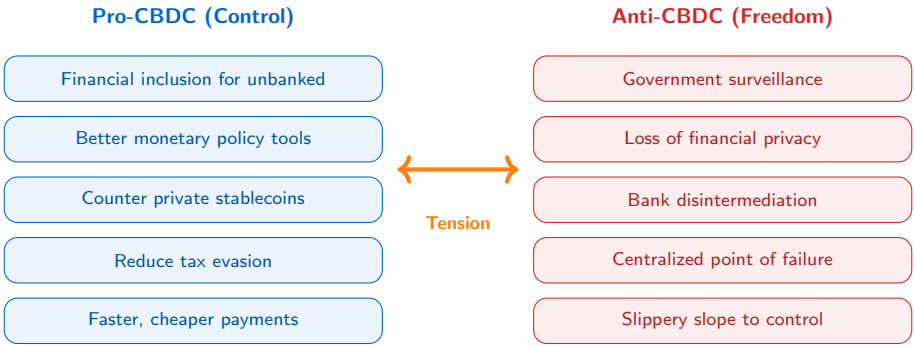
CBDC centralization risk:

- One central system holds the entire monetary base
- Nation-state attack surface: China, Russia, or criminal groups target *one* system
- A successful attack could freeze an entire economy
- 99.999% uptime ("five nines") means 5 minutes of downtime per year — is that enough?



"Five nines" (99.999%) availability is the gold standard for critical infrastructure — but even 5 minutes of CBDC downtime could cause panic.

The Political Debate: Control vs Freedom



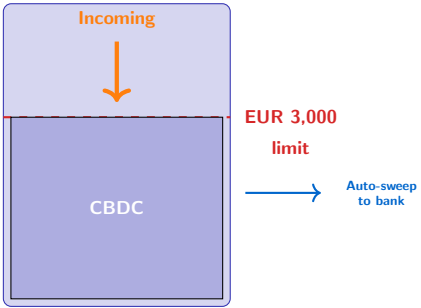
Every CBDC design is a political compromise between these competing values.

This debate mirrors broader tensions in digital governance: efficiency vs privacy, innovation vs regulation, state vs individual.

Holding Limits: The Compromise

How holding limits work:

- **Hard cap:** Maximum CBDC per person (ECB: EUR 3,000)
- **Tiered remuneration:** Penalty interest above threshold (e.g., -2% above EUR 3,000)
- **Auto-sweep:** Excess CBDC automatically converted to bank deposits
- **Waterfall mechanism:** Incoming payments above limit redirected to linked bank account



Why this works:

- Limits deposit flight during normal times
- Still allows large payments (flow through, not stored)
- Preserves banking system's funding base

The EUR 3,000 limit is debated — banks want lower (EUR 500), privacy advocates want higher or no limit.

CBDCs: Weighing the Arguments

Potential Benefits	Potential Risks
Financial inclusion (1.4B unbanked)	Bank disintermediation
Faster, cheaper cross-border payments	Privacy erosion
Better monetary policy transmission	Digital bank run acceleration
Counter private stablecoin monopolies	Cybersecurity single point of failure
Preserve central bank relevance	Complexity and implementation cost

Net assessment: Wholesale CBDCs offer clearer benefits with fewer risks. Retail CBDCs remain controversial.

The World Bank estimates 1.4 billion adults globally are "unbanked" — CBDCs could provide digital accounts without traditional banking.

Discussion: Would You Trust a Swiss e-Franc?

"Imagine the SNB launches a retail e-Franc tomorrow. Would you move money from your UBS/ZKB account into it?"

Points to consider:

- Switzerland's banking system is highly trusted — does an e-Franc add value?
- Swiss privacy traditions (banking secrecy) vs. CBDC traceability
- Would you trust the SNB more than UBS with your transaction data?
- The Credit Suisse collapse showed even "too big to fail" banks can fail — does CBDC help?

Banking secrecy has been a Swiss tradition since 1934 — but has eroded significantly under international pressure (FATCA, CRS, automatic exchange of information).

CBDC Scorecard: Comparing Approaches

Dimension	e-CNY	Digital Euro	Helvetia (CH)	United States
Type	Retail	Retail	Wholesale	None (FedNow)
Architecture	Two-tier	Two-tier	Two-tier	N/A
Privacy	Controllable anon.	Cash-like offline	Institutional	N/A
Status	Pilot (26 cities)	Preparation	Live pilot (SDX)	No plans
Holding limit	Dynamic	EUR 3,000	N/A (wholesale)	N/A
Motivation	Sovereignty, control	Financial inclusion	Settlement efficiency	"Not needed"

Pattern: No two countries take the same approach — each CBDC reflects its country's economic structure, political system, and values.

Switzerland's wholesale-only approach reflects its strong private banking sector and well-functioning payment infrastructure.

What CBDCs Will and Won't Solve

CBDCs CAN Address

- Cross-border payment inefficiency
- Financial inclusion for the unbanked
- Central bank relevance as cash disappears
- Settlement speed for securities
- Monetary policy transmission in crises

CBDCs CANNOT Solve

- Underlying economic inequality
- Trust in institutions (technology $\neq$ trust)
- Digital literacy gaps
- Cybersecurity threats (may worsen them)
- Political disagreements about money's purpose

A CBDC is a tool, not a solution. Its impact depends entirely on design choices, political context, and implementation quality.

Technology changes the "how" of money, not the "what" or "why" — the fundamental economics remain the same.

The Interplay: CBDC, Stablecoins, and Tokenized Deposits

Three Visions for Digital Money

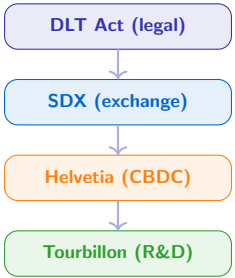
	CBDC	Stablecoins	Tokenized Deposits
Issuer	Central Bank	Private company (Circle, Tether)	Commercial bank
Technology	DLT or central database	Public blockchain	Permissioned DLT
Backing	Full faith of sovereign	Reserve assets (bonds, cash)	Deposit insurance
Risk	Disintermediation of banks	Run risk, de-peg events	Technology + operational risk
Use Case	Retail payments, financial inclusion	DeFi, cross-border, crypto trading	Wholesale, interbank settlement
Status	Pilots in 30+ countries	USD 150B+ market cap	Early stage (JPM Coin, SDX)

What This Means for Switzerland

Switzerland's strategic advantages:

- **SDX:** World's first regulated DLT exchange
- **Project Helvetia:** Live wholesale CBDC on production infrastructure
- **BIS Basel:** Innovation Hub next door — Tourbillon, mBridge
- **DLT Act (2021):** World's most advanced legal framework for digital assets
- **Crypto Valley (Zug):** Deep talent pool in blockchain and DLT

Switzerland's approach:
Don't rush retail — lead on wholesale. Build infrastructure first, let the use cases follow.



Swiss stack: law → exchange → CBDC → R&D

Switzerland passed its DLT Act in 2021 — the first country to create a complete legal framework for tokenized securities and DLT-based exchanges.

Key Takeaways

1. **CBDC = central bank digital money for the public or institutions.** It fills the gap between physical cash and private digital money. As cash disappears, CBDCs preserve central banks' direct role.
2. **Design choices are trade-offs, not technical problems.** Retail vs wholesale, account vs token, privacy vs compliance — each choice reflects political values, not just engineering.
3. **China leads on scale; Europe leads on privacy; Switzerland leads on wholesale.** There is no single "best" CBDC design — each approach reflects its country's unique context.
4. **Bank disintermediation is the biggest risk.** Holding limits, tiered remuneration, and two-tier architecture are the tools to manage it — but no design eliminates the risk entirely.
5. **The future is pluralistic.** CBDCs, stablecoins, and tokenized deposits will likely coexist — each serving different users, use cases, and risk profiles.

These five takeaways map to the five learning objectives from slide 3.

Looking Ahead: From CBDCs to Broader Infrastructure

Connections:

- **M6L4 (Tokenization):** CBDCs as settlement currency for tokenized assets (Project Helvetia)
- **M8 (Regulation):** Legal frameworks (DLT Act, Digital Euro regulation) that govern CBDCs
- **Cross-cutting:** CBDCs touch every module — payments, trust, AI (fraud detection), and regulation

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CBDCs are infrastructure — they connect to payments (M6L1), trust (M3), tokenization (M6L4), and regulation (M8).

Further Reading

Core Papers and Reports:

- Bech, M. & Garratt, R. (2017). "Central bank cryptocurrencies." *BIS Quarterly Review*, September 2017. [The Money Flower paper]
- BIS (2024). "Project mBridge: Connecting economies through CBDC." [Cross-border CBDC]
- ECB (2023). "A stocktake on the digital euro." [Digital Euro design]
- SNB (2024). "Project Helvetia Phase III." [Swiss wholesale CBDC]
- BIS Innovation Hub (2023). "Project Tourbillon." [Privacy + compliance]

Online Resources:

- Atlantic Council CBDC Tracker: `https://www.atlanticcouncil.org/cbdctracker/`
- BIS Innovation Hub: `https://www.bis.org/about/bisih/topics/cbdc.htm`

Start with the Bech & Garratt (2017) paper for the conceptual framework, then read the Helvetia reports for Swiss context.

Swiss Study Resources

Swiss-Specific Sources:

- SNB: https://www.snb.ch — Speeches and working papers on CBDC
- FINMA (Swiss Financial Market Supervisory Authority): https://www.finma.ch — Regulatory guidance on digital assets
- SIX Digital Exchange (SDX): https://www.sdx.com — Switzerland's DLT exchange
- BIS Basel: https://www.bis.org — Global standards, Innovation Hub projects
- Swiss Bankers Association: Reports on CBDCs and digital finance

Key Swiss Policy Documents:

- Federal Council (2022): "Legal framework for DLT" — the DLT Act explained
- SNB (2024): "Wholesale CBDC — Project Helvetia learnings"
- BIS Innovation Hub Basel (2023): "Project Tourbillon — Privacy in CBDC"

FINMA = Swiss Financial Market Supervisory Authority. It regulates banks, insurance, exchanges, and now digital asset service providers.

The Future of Money

The future has 12 types of money but still only 2 ways to pay

No matter how money evolves — CBDC, stablecoins, tokens — the user experience will converge: tap, swipe, done.

Appendix: Where Retail CBDCs Are Stalling, and Why

The core lecture presents CBDCs as an engineering design space. Critics argue the real story is adoption failure, programmability creep, and political opposition — all empirically observable by 2025.

Adoption: the live pilots that did not catch on

- **Nigeria eNaira** (Oct 2021–): <0.5% of adult population active; <0.15% of retail transactions (*IMF Working Paper WP/23/104, "Nigeria's eNaira, One Year After," May 2023*, 2022–2023) — after 2 years plus cash-withdrawal restrictions designed to force usage
- **Bahamas Sand Dollar** (Oct 2020–): ~$2M in circulation, <0.5% of currency in circulation (*Central Bank of The Bahamas, Sand Dollar Q3 2024 Report*, 2024)
- **Jamaica JAM-DEX** (2022–): ~260k wallets, most acquired via sign-up incentive (*Bank of Jamaica Quarterly Monetary Policy Report, 2024*, 2024)
- **ECCB DCash:** went offline for 2 months (*ECCB press statement, Jan 14 2022*, 2022) in Jan–Mar 2022 — certificate-expiry outage; subsequently wound down

Programmability: what critics actually fear

- **China e-CNY** shipped with "expiry dates" and merchant-category restrictions (*PBoC e-CNY White Paper, July 2021; BIS Paper No. 123, Jan 2022*, 2021–2022) in pilot city red-envelope promotions — i.e., *programmable money in the exact sense ECB promises it won't build*
- China expanded e-CNY onto cross-border mBridge with UAE, Thailand, Hong Kong, Saudi Arabia (*BIS Project mBridge minimum-viable-product report, June 2024*, 2024) — later BIS exited mBridge (Nov 2024) over governance concerns

Most retail-CBDC pilots are in trough-of-disillusionment territory by 2024–25. Whether that is a temporary dip or a structural verdict is the open question.

Appendix: The 2024–25 Political Backlash — Voices, Laws, Orders

CBDC debates are no longer technical. In 2024–25 they became electoral.

United States

- **Trump Executive Order 14178** (Jan 23 2025): "prohibits the establishment, issuance, circulation, and use of a CBDC within the jurisdiction of the United States" (*EO 14178, "Strengthening American Leadership in Digital Financial Technology," Fed. Reg. Jan 23 2025*, 2025)
- **CBDC Anti-Surveillance State Act** passed US House May 2024 216–192 (*H.R. 5403 roll call vote, May 23 2024*, 2024)
- **Ron DeSantis, Florida** (Mar 2023): state statute explicitly excluding CBDC from legal definition of money
- **Academic:** Eswar Prasad (*The Future of Money*, 2021) — supportive; Cato Institute, Nick Anthony (*Anthony, "The Risks of CBDCs," Cato Briefing Paper, 2023*, 2023) — opposed on privacy grounds

EU, UK, Switzerland

- **Digital Euro privacy pushback:** EDPS (EU Data Protection Supervisor) "offline digital euro must be cash-like, i.e., anonymous" (*EDPS Opinion 44/2023 on Digital Euro Regulation proposal, Oct 2023*, 2023)
- **Bundesbank board member Burkhard Balz:** holding limits necessary precisely because disintermediation risk is *real*, not theoretical (BIS speech, 2023)
- **UK House of Lords Econ Affairs Cttee (Jan 2022)**: "a solution in search of a problem" (*House of Lords Economic Affairs Committee, 3rd Report of Session 2021–22, HL Paper 131, Jan 2022*, 2022)
- **Switzerland:** SNB position since 2019 is that a *retail* Swiss-franc CBDC "would not generate additional benefits commensurate with the new risks" — only Project Helvetia (wholesale) is live
- **Academic:** Cecilia Skingsley (Riksbank/BIS Innovation Hub) — supportive; Itai Agur / IMF ("The Political Economy of CBDC Adoption" (*Agur, Ari, Dell'Ariccia, Journal of Monetary Economics 2022*, 2023)) — notes adoption requires coercion or intermediary cooperation

The unresolved tradeoff: Privacy-preserving offline design (EDPS, Tourbillon) and AML-compliant design (FATF Travel Rule) pull in opposite directions. Every CBDC jurisdiction is choosing where on that axis to sit — and the choice is