

Central Bank Digital Currencies (CBDCs)

L03: The Economics of Public Digital Money

Economics of Digital Finance

BSc Course

Today's Topics

1. CBDC design choices and trade-offs
2. Monetary policy transmission
3. Bank disintermediation risk
4. Financial inclusion economics
5. International currency competition

Learning Objectives

- Analyze CBDC design trade-offs
- Assess monetary policy implications
- Evaluate disintermediation risks
- Understand global CBDC landscape

CBDCs represent central banks' response to private digital currencies

What is a Central Bank Digital Currency?

Definition

A CBDC is a digital form of central bank money:

- Direct liability of central bank
- Digital (not physical)
- Widely accessible (retail) or restricted (wholesale)

Not a CBDC

- Bank reserves (already digital)
- Commercial bank money
- Stablecoins (private liability—can collapse, as Terra/UST did in 2022 losing \$40B+)

Motivations

Central banks cite multiple goals:

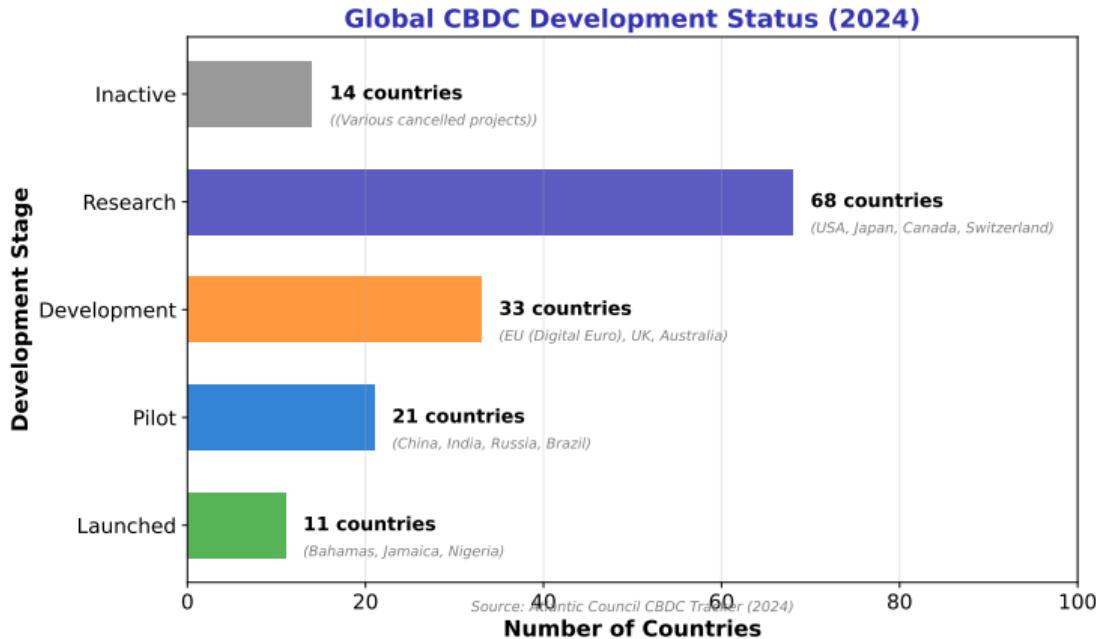
- Maintain monetary sovereignty (control over the nations money supply)
- Improve payment efficiency
- Promote financial inclusion
- Counter private digital currencies

Key Economic Question

Does public benefit exceed costs and risks?

CBDC = digital cash issued by central bank; distinct from existing digital money

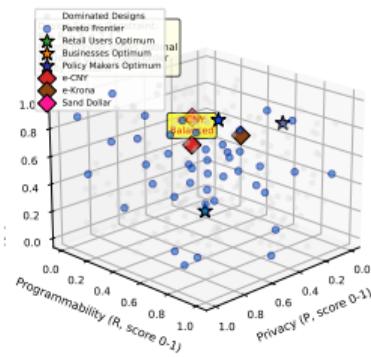
Global CBDC Development Status



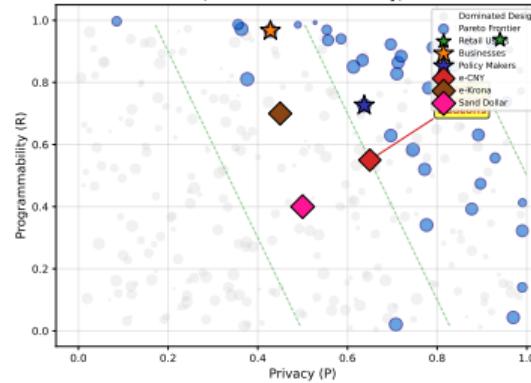
130+ countries exploring CBDCs; China's e-CNY (digital yuan) is most advanced large-economy pilot

CBDC Design Space: Key Choices

CBDC Design Space: Multi-Attribute Utility Trade-offs



2D Projection: Privacy vs Programmability
(Bubble size = Accessibility)



Theory: Keeney & Raiffa (1976) Multi-Attribute Utility Theory | Constraint: Cannot maximize all three attributes simultaneously

Design choices involve trade-offs between privacy, efficiency, and policy goals

Retail CBDC

For general public use:

- Replaces/complements cash
- Consumer payment instrument
- Requires distribution network

Economic considerations:

- High operational costs
- Privacy vs. AML (Anti-Money Laundering) trade-off
- Competition with banks

Wholesale CBDC

For financial institutions:

- Interbank settlement (transferring money between banks)
- Securities transactions
- Cross-border payments

Economic considerations:

- Lower operational burden
- Efficiency gains clearer
- Less disruptive to banking

Most advanced economies focus on retail; wholesale offers clearer near-term benefits

Token-Based

Like digital cash:

- Verify the instrument, not holder
- Can enable anonymity
- Offline transactions possible

Economic implications:

- Lower transaction costs
- Privacy preserving
- Harder to implement AML

Account-Based

Like bank accounts:

- Verify the identity of holder
- Full transaction records
- Programmable features possible (money with built-in rules, like expiration dates)

Economic implications:

- Interest-bearing feasible
- Targeted policies possible
- Privacy concerns

Most designs are hybrid: token-like for small values, account-like for large

Traditional Channels

Interest rate channel:

$$i_{\text{policy}} \rightarrow i_{\text{deposit}} \rightarrow C, I$$

- Works through bank intermediation
- Banks pass rate changes to customers
- Time lags in transmission

CBDC Impact

If CBDC is interest-bearing:

$$i_{\text{CBDC}} \rightarrow i_{\text{deposit}}$$

- Direct transmission to public
- Floor on deposit rates

CBDC could strengthen monetary policy but raises political economy concerns

Enhanced Policy Options

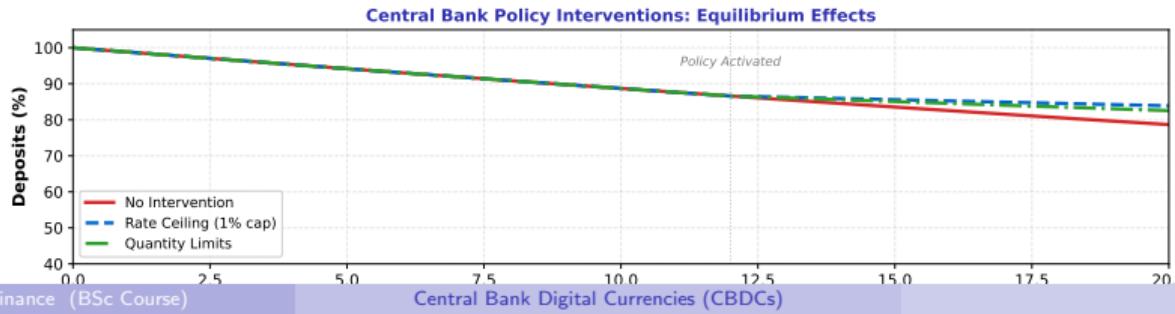
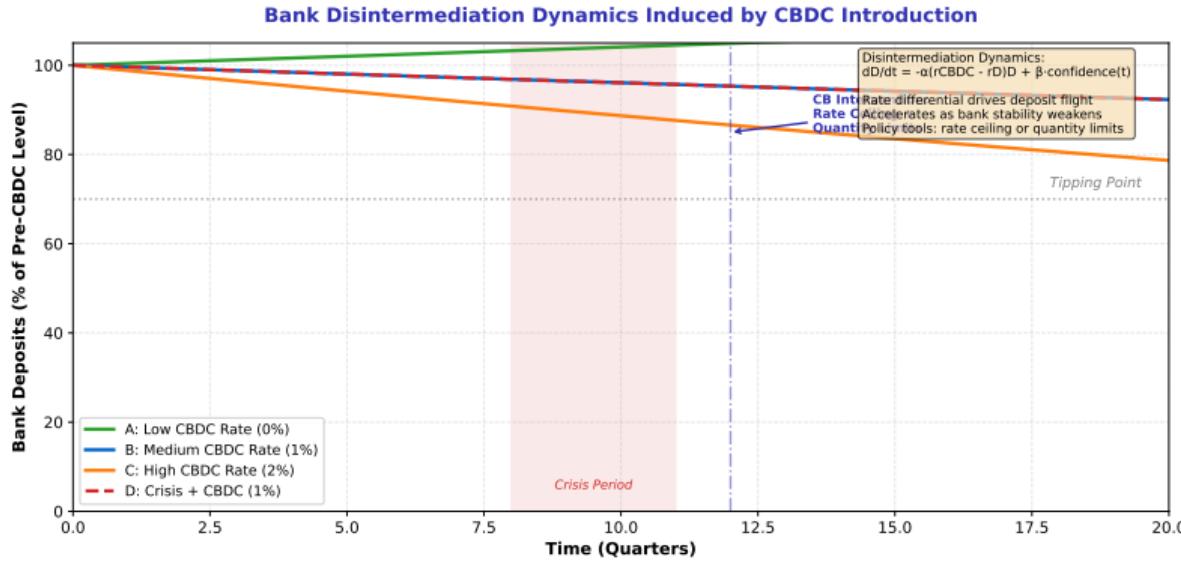
Interest-bearing CBDC enables:

- Negative interest rates (charging people to hold money, to encourage spending)
- Helicopter money (direct cash from central bank to citizens—named for the image of dropping money from helicopters)
- Time-limited money (expiring)

Concerns

- Political resistance to negative rates (*Why accept losing money? Without physical cash, people cannot escape—some see this as coercive.*)
- Privacy implications of targeting
- Complexity of implementation

Bank Disintermediation Risk



The Concern

If CBDC is attractive:

- Deposits migrate to CBDC
- Banks lose cheap funding
- Credit supply may contract

Example: If 20% of deposits move to CBDC, banks must borrow elsewhere at higher rates, meaning fewer or costlier loans.

Andolfatto (2021), a Federal Reserve economist, modeled this:

- CBDC as outside option
- Forces competitive deposit rates
- Net welfare effect ambiguous

Mitigation Strategies

Design features to limit migration:

- Holding limits (e.g., 3000 EUR)
- Tiered remuneration (different rates for different amounts—e.g., 0% up to 3000 EUR, negative above)
- No interest on CBDC

Financial Stability

- Digital bank runs faster (instant CBDC transfers vs. slow cash withdrawals)
- Flight to safety amplified (the rush to safe assets is faster when transfers are instant)
- Requires careful design

Design constraints trade off CBDC usefulness against banking system stability

The Unbanked Problem

Globally 1.4 billion unbanked adults:

- Lack documentation for accounts
- Live far from bank branches
- Cannot afford minimum balances

CBDC Potential

- Lower KYC (Know Your Customer) requirements for small values
- Mobile-based access
- No minimum balance required

Economic Analysis

Benefits:

- Lower transaction costs
- Entry to formal finance
- Government transfer efficiency

Challenges:

- Digital divide persists
- Infrastructure requirements
- Financial literacy needs

Inclusion requires complementary policies; technology alone is insufficient

Currency Competition

CBDCs could intensify:

- Cross-border CBDC use
- Challenge to dollar dominance
- Regional currency blocs

China's Strategy

- e-CNY for domestic use
- mBridge (a multi-CBDC platform connecting central banks) for wholesale cross-border
- Reduce dependence on SWIFT (the global interbank messaging system)

US Response Dilemma

- Digital dollar slower to develop
- Privacy concerns prominent
- Risk of losing first-mover advantage

Economic Implications

- Seigniorage redistribution
- Sanctions effectiveness
- Monetary policy spillovers

CBDCs add new dimension to international monetary system competition

Current Pain Points

- High costs (average 6%)
- Slow settlement (2-5 days)
- Limited transparency
- Correspondent banking (international payments through intermediary banks)

Example: A worker sending \$200 home may lose \$12 in fees and wait 3 days.

Wholesale CBDC Solution

- Direct central bank settlement
- Atomic swap (both sides of exchange happen together, or neither happens)
- 24/7 operation possible

Multi-CBDC Projects

- mBridge (China, UAE, HK, Thailand)
- Project Dunbar (Singapore, Australia)
- Project Icebreaker (Nordic countries)

Economic Benefits

- Reduced FX (foreign exchange) settlement risk
- Lower remittance costs
- Faster trade finance

Wholesale CBDCs show clearer efficiency gains for cross-border payments

Privacy Concerns

- Government surveillance potential
- Transaction tracking
- Political control over spending

Design Options

- Tiered privacy (small = anonymous)
- Zero-knowledge proofs (proving you meet a requirement without revealing your data)
- Third-party anonymity services

Policy Control Benefits

- AML/CFT (Combating the Financing of Terrorism) compliance
- Tax enforcement
- Targeted stimulus

Economic Framework

Trade-off function:

$$U = f(\text{Privacy, Policy Effectiveness})$$

- Social preferences vary by country
- No one-size-fits-all design

Privacy preferences differ: Germany (with Stasi memories) values privacy; China's social credit system reflects different norms

Case Study: The Digital Euro

ECB (European Central Bank) Design Principles

- Complement to cash, not replacement
- Privacy by design (small payments)
- Holding limits (~3000 EUR proposed)
- No interest initially

Timeline

- Investigation phase: 2021-2023
- Preparation phase: 2023-2025
- Potential launch: 2027-2028

Economic Rationale

- Strategic autonomy (not dependent on Visa, Mastercard, or US tech giants)
- Payment system resilience
- Declining cash usage

Criticisms

- Banks lobby against disintermediation
- Privacy advocates concerned
- Unclear consumer demand

Digital Euro reflects European values: privacy, strategic autonomy, bank coexistence

Main Conclusions

1. CBDC design involves fundamental trade-offs
2. Disintermediation risk requires mitigation
3. Monetary policy transmission could improve
4. International competition is intensifying

Core Insight

CBDCs are not simply “digital cash”—they require careful economic analysis of trade-offs between competing objectives. No design satisfies all goals simultaneously.

Economic Framework

- Retail vs. wholesale scope
- Token vs. account architecture
- Privacy vs. policy control
- Inclusion vs. stability

Next lesson: Payment Systems Economics

Key Terms (1/2)

CBDC (Central Bank Digital Currency) Digital form of central bank money, a liability of the central bank denominated in the national unit of account.

Retail CBDC CBDC available to the general public for everyday transactions.

Wholesale CBDC CBDC restricted to financial institutions for interbank settlements.

Token-Based CBDC CBDC where validity is verified by the instrument itself (like cash), enabling offline transactions.

Account-Based CBDC CBDC where validity requires verification of the holder's identity against an account.

Bank Disintermediation Risk that CBDC adoption draws deposits away from commercial banks, reducing their lending capacity.

Monetary Sovereignty A nation's ability to control its own money supply and monetary policy independently.

Seigniorage The profit a government earns from issuing currency—the difference between the face value of money and its production cost.

AML (Anti-Money Laundering) Laws and regulations designed to prevent criminals from disguising illegally obtained money as legitimate income.

KYC (Know Your Customer) The process of verifying the identity of customers, required by financial regulations.

Terms continued on next slide

Key Terms (2/2)

Correspondent Banking An arrangement where one bank provides services on behalf of another, commonly used for international payments.

Atomic Swap A technology enabling exchange of different currencies simultaneously—both transfers complete or neither does.

Wholesale Funding Money banks borrow from other financial institutions (rather than customer deposits) to fund operations.

Tiered Remuneration Different interest rates for different amounts held—e.g., 0% on first 3000 EUR, negative rates above.

Helicopter Money Direct cash transfers from central bank to citizens, bypassing banks—named for the image of dropping money from helicopters.

Negative Interest Rates A policy where depositors pay to keep money in accounts rather than earning interest—used to encourage spending.

Interbank Settlement The process by which banks transfer money between themselves to complete transactions.

Flight to Safety When investors move money from risky assets to safe ones during uncertainty—with CBDC, could mean moving from bank deposits to CBDC.

Financial Inclusion Ensuring all people have access to useful and affordable financial services.

Zero-Knowledge Proofs Cryptography that proves you meet a requirement without revealing your data—like proving you're over 18 without showing your birthdate.

CBDC design choices have profound implications for monetary policy and financial stability

Academic Papers

- Andolfatto (2021): “Assessing the Impact of CBDC on Private Banks”
- Brunnermeier & Landau (2022): “The Digital Euro”
- Auer et al. (2022): “CBDCs Beyond Borders”

Central Bank Publications

- ECB (2023): “A Stocktake on the Digital Euro”
- BIS – Bank for International Settlements (2021): “CBDCs: An Opportunity for the Monetary System”
- Fed – Federal Reserve (2022): “Money and Payments”

All readings available on course platform