

Will Central Bank Digital Currency Disintermediate Banks?

NBER Summer Institute: Risks of Financial Institutions

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What is a CBDC?



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- ▶ Different from **existing digital money**: CBDC is a direct liability of the central bank rather than that of a commercial bank
- ▶ Different from **existing central bank accounts**: CBDC can be held by the public, not just banks

The increasing popularity of CBDC

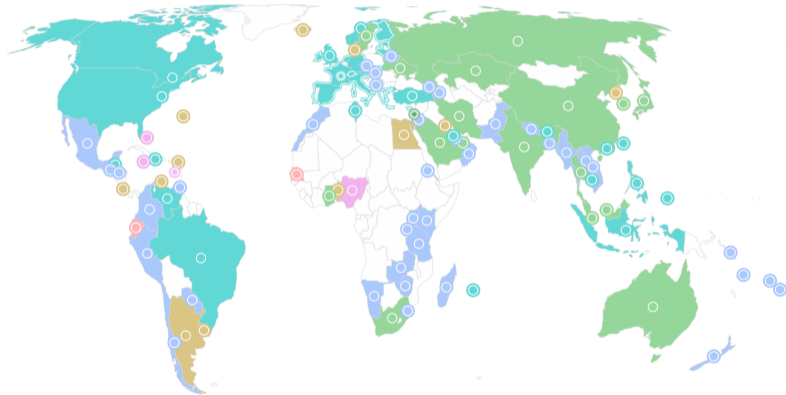
data source: <https://www.atlanticcouncil.org/cbdctracker/>

120 Countries / Currency
Unions Tracked

Click to filter

Status

- 11 Launched
- 18 Pilot
- 32 Development
- 40 Research
- 15 Inactive
- 2 Canceled



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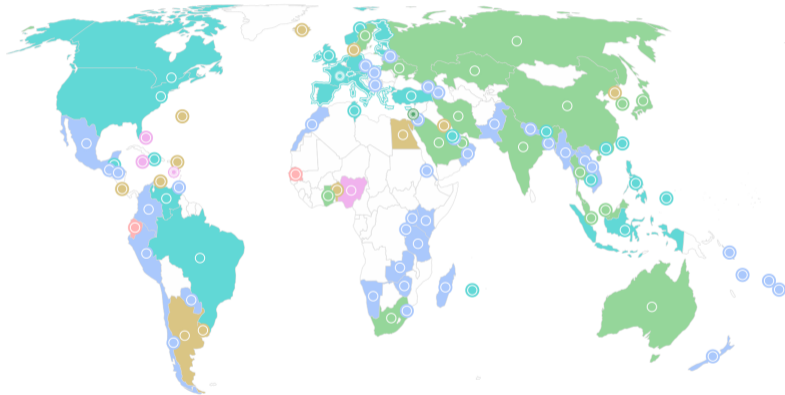
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▶ CBDC countries account for over 95% of global GDP

Concerns about CBDC

*"A widely available CBDC [...] could reduce the aggregate amount of deposits in the banking system, which **could** in turn **increase bank funding expenses**, and **reduce credit availability** or raise credit costs."*

—“Money and Payments: The U.S. Dollar in the Age of Digital Transformation”, Federal Reserve, 2022.

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*“Given that the average loan-to-deposit ratio for banks is generally around 1:1, **every dollar** that migrates from commercial bank deposits to CBDC **is one less dollar of lending**.”*

—“Confronting the hard truths and easy fictions of a CBDC”, President of Bank Policy Institute, 2021

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- ▶ We estimate a dynamic banking model:
 - households: **demand** assets, based on interest rate & non-rate factors (estimated via BLP)
 - banks: take deposits/supply loans, in the presence of **frictions** (estimated via SMD)

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Quantify: the **elasticity of substitution** between CBDC and bank deposits
the **pass-through** from deposits to loans

Model overview

Time: 1, 2, 3 ...

Three players:

1. Depositors: simple, choose where to invest wealth
2. Borrowers: simple, choose (whether or not) how much to borrow
3. Banks: make dynamic optimization decisions ...

Imperfect competition in the deposit market

- ▶ Households choose from: savings/transaction deposits from J oligopolistic banks, cash (and CBDC, in the counterfactual exercise), outside option (short-term bonds) to:

$$\max_{j \in \mathcal{A}^d} \pi_{i,j}^d = \alpha_i^d r_j^d + q_{i,j}^d + \epsilon_{i,j}^d$$

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- r_j^d is the rate
- $q_{i,j}^d \equiv \beta_i^d \times x_j^d$ is the “quality”
 - * non-rate characteristics: #branch network, transaction convenience, ... and FEs
- $\epsilon_{i,j}^d$ is a preference shock (imperfect substitution)

Households differ in sensitivities to rate/non-rate characteristics ($\{\alpha, \beta\}$ are heterogeneous)

Imperfect competition in the loan market

- ▶ Same set of J oligopolistic banks & mass 1 of borrowers (firms) who can borrow from a bank, issue a bond, or not borrow, to

$$\max_{j \in \mathcal{A}^d} \pi_{i,j}^l = q_{i,j}^l - \alpha_i^l r_j^l + \epsilon_{i,j}^l$$

- q_j^l is benefit from borrowing (and thus being able to invest), minus the issuance costs
- r_j^l is the interest rate charged
- $\epsilon_{i,j}^l$ captures any firm-bank relationship

Banks' problem

- ▶ Impose the standard assumption that ϵ follows a type I extreme value distribution
- ▶ We can calculate the total deposit and loan demanded for bank j :

$$D_j^S(r^{d,S}) = \int_i \frac{\exp(\alpha_i^d r_j^{d,S} + q_{i,j}^{d,S})}{\sum_{k \in \mathcal{A}^d} \exp(\alpha_i^d r_k^d + q_{i,k}^d)},$$

$$D_j^T(r^{d,T}) = \int_i \frac{\exp(\alpha_i^d r_j^{d,T} + q_{i,j}^{d,T})}{\sum_{k \in \mathcal{A}^d} \exp(\alpha_i^d r_k^d + q_{i,k}^d)},$$

$$B_j(r^l) = \int_i \frac{\exp(q_{i,j}^l - \alpha_i^l r_j^l)}{\sum_{k \in \mathcal{A}^l} \exp(q_{i,k}^l - \alpha_i^l r_k^l)}$$

The remaining bank balance sheet

Assets		Liabilities	
Existing loans	L	Deposits	$D^S(r^{d,S}) + D^T(r^{d,T})$
New loans	$B(r^l)$		
Required Reserves	R	Wholesale borrowing	N
Government securities	G	Equity	E
Total Assets	$L + B + R + G$	Total Liabilities and Equity	$D + N + E$

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Bank's choice in a static, frictionless world

1. No financial frictions
2. No regulatory constraints
3. No maturity mismatch

$$\Pi = \max_{\{r^l, r^d\}} r^l L_j - r^{d,S} D_j^S - r^{d,T} D_j^T - f(L_j - D_j^S - D_j^T)$$

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- * the optimal lending and deposit rates:

$$r_j^{d,T/S} = f - \left(\frac{D_j^{T/S'}}{D_j^{T/S}} \right)^{-1} ; r_j^l = f + \left(-\frac{L_j'}{L_j} \right)^{-1}$$

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Irrelevance result: deposit-taking and loan-origination are **separable** in the frictionless benchmark

Intuition behind the irrelevance result

- ▶ If banks can frictionlessly access wholesale funding, then loans should be priced w.r.t. the market interest rate rather than deposit rates

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- ▶ If banks can frictionlessly access wholesale funding, then loans should be priced w.r.t. the market interest rate rather than deposit rates
- ▶ Accessing cheap deposits makes banks **overall more profitable** but does not make lending more profitable **at the margin**
- ▶ Clarify some confusions in the current discussion of CBDC:
 - e.g., “given that loan-to-deposit ratio is 1:1, every dollar that migrates from deposits to CBDC is one less dollar of lending.”

Potential disintermediation channels

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 2. Regulation, e.g. capital requirement:
 - CBDC reduces bank capital, constraining lending capacity
 3. Maturity transformation:
 - Banks' market power makes deposits effectively long duration; CBDC changes banks' asset composition and their interest risk exposure

Banks' choice in a dynamic model with frictions

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*Bank defaults and is auctioned off when $V < 0$

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1+2+3 connects banks' optimal deposit and lending decisions

Characterize our solution

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- ▶ A Perfect Bayesian Equilibrium occurs when:
 1. All agents optimize
 2. All markets clear
 3. Everyone has rational expectation

IO estimation in a dynamic banking model

We divide our estimation into two stages:

1. **First stage:** estimate deposit/loan demand via BLP
 - how consumers' utilities (portfolio share) vary with rates
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 - match banks' profit margin, funding structure, ...
- ▶ Untargeted moments:
- bank credit spread
 - time series variations of deposit and loan rates

We introduce CBDC

- ▶ We model a new product (CBDC) as a **“bundle” of characteristics**
 1. may bear some interest rate (baseline: 0%)
 2. offers transaction convenience like transaction deposits
 3. has the same issuer FE as cash
 4. carries a “digital premium”
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- ▶ Large **uncertainty in the “quality”** perception of CBDC
 - we vary the CBDC “quality” parameter and calculate the elasticity of bank behaviors ...

Counterfactuals: varying CBDC quality

	(1) No CBDC	$\times q_{CBDC}$				(6) Sensitivity
		(2) 25%	(3) 50%	(4) 75%	(5) 100%	
(1) CBDC Share	0.000	0.005	0.012	0.030	0.076	1.000
(2) Deposits	0.876	0.872	0.868	0.851	0.814	-0.815
(3) Cash	0.070	0.069	0.068	0.066	0.062	-0.107
(4) Loan	1.021	1.016	1.015	1.016	1.007	-0.189
(5) Deposit spread (%)	1.125	1.117	1.117	1.113	1.092	-0.432
(6) Loan spread (%)	2.177	2.182	2.183	2.182	2.189	0.147
(7) Bank credit spread (%)	0.100	0.112	0.112	0.112	0.132	0.414
(8) Funding cost (%)	1.291	1.305	1.321	1.335	1.357	0.874
(9) Bank value	1.846	1.843	1.835	1.833	1.821	-0.338

- One dollar increase in CBDC decreases deposits by 82 cents,
...the effect on loans is much smaller (19 cents)

Alternative implementation

Interest-bearing CBDC: pays an interest ranging from 0% to 100% of FFR

- crowds out bank deposits more strongly
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(2) central bank will reimburse private banks for their service

- (1) could lead to larger outflow of deposits from the banking system (dominates mostly)
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Across all cases: a **small fraction** of deposit market effect ($< 1/3$) is passed through to loan provision

The heterogeneous Impact of CBDC

1. Among smaller banks:

- \$1 CBDC decreases lending of **big** (**small**) banks by **14.6** (**40.7**) cents
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- \$1 CBDC decreases lending by **5 cents** (**42 cents**) when the county-level market concentration is at the **50th** (**90th**) percentile
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▶ CBDC is likely to have **important redistributive effects**

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- ▶ Consider banks' costly equity issuance

Conclusion: we provide a framework to quantify the impact of CBDC on bank behavior

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Subsample analysis implies that the effect can be more significant for smaller & more competitive banks