

Will Central Bank Digital Currency Disintermediate Banks?

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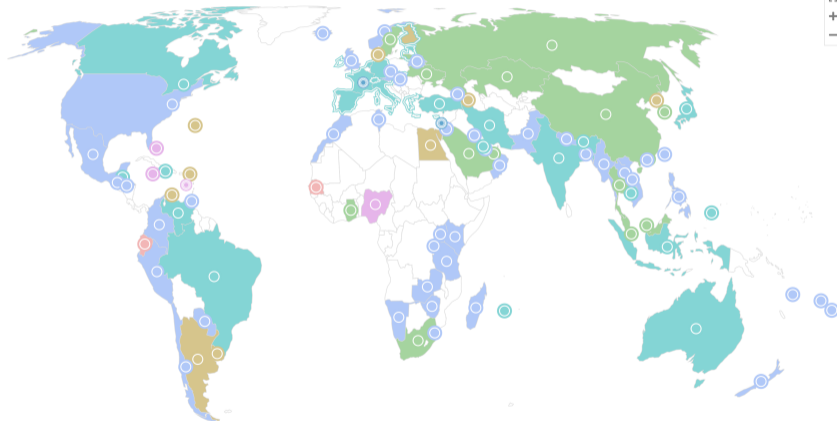
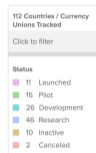
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What is a CBDC?

- ▶ A central bank digital currency (CBDC) is a country's official currency in digital form
- ▶ Different from existing digital money such as bank deposits:
 - ▶ CBDC is a direct liability of the central bank rather than a commercial bank
- ▶ Different from any existing central bank liabilities, e.g., bank reserves:
 - ▶ CBDC can be held by the general public, not just banks

CBDC has been increasing in popularity*



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

CBDC is not without controversy

“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 or raise credit costs for households and businesses.”

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

This debate motivates our central research question

How and **how much**

does CBDC influence banks' deposits, credit provision, and stability?

We answer this question in three steps

- ▶ Establish an irrelevance result
 - ▶ In a frictionless world, deposits and loans are entirely separable
 - ▶ CBDC should have no impact on bank lending

- ▶ Build a quantitative banking model
 - ▶ Contains frictions that allow a CBDC to affect bank lending
 - ▶ Fit the model to U.S. data

- ▶ Counterfactually add CBDC to examine its impact
 - ▶ Analogous to an IO analysis of how an entrant changes market structure

Effects on money creation

- ▶ CBDC can replace a significant fraction of private money creation
- ▶ The impact is much larger if CBDC pays interest
- ▶ In both cases, banks become less profitable

Effect on credit supply is three times smaller than the effect on deposits

- ▶ Banks replace lost deposits with wholesale funding
- ▶ Effect differs across large and small banks

Additional implication for bank stability

- ▶ Limits the “natural hedge” of interest-rate risk from deposits
- ▶ Slows recapitalization following negative shocks

Dynamic, Infinite Horizon Model Overview:

- ▶ Three players:
 - ▶ Depositors: simple, choose where to invest wealth
 - ▶ Borrowers: simple, choose whether and how much to borrow
 - ▶ Banks: make dynamic optimization decisions
- ▶ CBDC:
 - ▶ absent when we estimate the model
 - ▶ introduced to examine model predictions

We estimate the demand for deposits and loans (Berry, Levinsohn, and Pakes 1995)

- ▶ Logistic deposit regressions contain:
 - ▶ deposit rates
 - ▶ non-rate characteristics: # of branches, employees per branch, etc.
 - ▶ issuer and time fixed effects
 - ▶ transactions convenience dummy: 1 for transaction deposits
- ▶ Harvest
 - ▶ demand elasticities
 - ▶ fitted value of the other regressors \equiv “quality”

- ▶ Logistic loan regressions are similar
- ▶ Harvest demand elasticities

The Bank Balance Sheet

Assets		Liabilities	
Existing loans	L_t	Deposits	D_t
New loans	$B_t(r_t)$	Non-reservable borrowings	N_t
Reserves	R_t		
Government securities	G_t	Equity	E_t
Total Assets	$L_t + B_t + R_t + G_t$	Total Liabilities and Equity	$D_t + N_t + E_t$

- ▶ Reserves and government securities earn the federal funds rate

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- ▶ Deposits are insured, nonreservables are not
- ▶ Default is possible under insolvency
- ▶ Lenders of nonreservables charge a spread over the federal funds rate such that they break even, $r_N - f > 0$

Frictionless benchmark

- ▶ No financial frictions, no regulatory constraints, no maturity mismatch
- ▶ Banks maximize

$$\Pi = \max_{\{r^l, r^d\}} r^l L - r^d D - f(L - D)$$

where f is the federal funds rate, r^d is the deposit rate, r^l is the lending rate

- ▶ The optimal lending and deposit rates:

$$r^l = f + \left(-\frac{L'}{L}\right)^{-1}$$

$$r^d = f - \left(\frac{D'}{D}\right)^{-1}$$

- ▶ Irrelevance: deposit-taking and loan-origination are separable in the frictionless benchmark
- ▶ If CBDC crowds out deposits, it has no effect on lending in the absence of frictions

Intuition behind the irrelevance result

- ▶ If banks can frictionlessly access wholesale funding, then loans should be priced at the market interest rate.
- ▶ Accessing cheap deposits makes banks more profitable, but does not make **lending** more profitable at the margin
- ▶ The argument “given that loan-to-deposit ratio is 1:1, every dollar that migrates from deposits to CBDC is one less dollar of lending” is conceptually wrong
- ▶ The irrelevance result allows us to isolate the various frictions that do allow a CBDC to affect the banking system.

Frictions that allow a CBDC to affect the banking system

- ▶ External financing frictions:
 - ▶ More uninsured wholesale funding increases default, consequently funding costs
- ▶ Regulation
 - ▶ CBDC reduces bank capital, constraining lending capacity
- ▶ Interest-rate risk from maturity transformation:
 - ▶ Banks' market power makes deposits effectively long duration
 - ▶ CBDC changes banks' asset composition and their interest risk exposure

Banks Maximize Discounted Cash Dividends to Shareholders

- ▶ They choose
 - ▶ loan and deposit rates (estimated demand elasticities give us quantities!)
 - ▶ reserves and government securities
 - ▶ non-reservable borrowing
- ▶ Taking the behavior of other banks as given
- ▶ Subject to constraints
 - ▶ Dividends = Deposit Profits + Loan Profits + Δ Equity
 - ▶ Capital regulation: $\kappa \times \text{Loans} \leq \text{Equity}$
 - ▶ Reserve regulation: $\theta \times \text{Deposits} \leq \text{Reserves}$
 - ▶ Negative dividends are not allowed
- ▶ Bank defaults and is auctioned off when $V < 0$

Hybrid Estimation of the Dynamic Banking Model

We divide our estimation into two stages:

- ▶ First stage: estimate deposit/loan demand systems via BLP
 - ▶ rate sensitivities
 - ▶ value attached to non-rate characteristics
 - ▶ Use salaries and expenses related to fixed assets as instruments.
- ▶ Second stage: estimate the remaining parameters, including the financing costs (SMM)

How to conceptualize CBDC in this framework

- ▶ We model a new product (CBDC) as a “bundle” of characteristics
 - ▶ It offers some rate of return (baseline: 0%)
 - ▶ It allows households to make transactions, as do transaction deposits
 - ▶ As a baseline, we assign it an issuer FE that is the same as cash
 - ▶ We add a “digital premium,” (Koont 2022)
- ▶ These attributes then define CBDC

There is large uncertainty in the “quality” of CBDC

- ▶ Depends on the exact implementation
- ▶ So we vary quality to calculate the elasticity of loans and deposits to CBDC.
- ▶ Under different implementations

Counterfactuals: Varying CBDC Quality

	(1) No CBDC	$\times q_{CBDC}$				(6) Sensitivity
		(2) 25%	(3) 50%	(4) 75%	(5) 100%	
CBDC Share	0.000	0.005	0.012	0.030	0.076	1.000
Transaction deposits	0.589	0.585	0.581	0.566	0.541	-0.634
Savings deposits	0.287	0.287	0.287	0.285	0.272	-0.197
Loan	1.021	1.016	1.015	1.016	1.007	-0.189
Cash	0.070	0.069	0.068	0.066	0.062	-0.107
Deposit spread (%)	1.125	1.117	1.117	1.113	1.092	-0.432
Loan spread (%)	2.177	2.182	2.183	2.182	2.189	0.147
Bank CDS spread (%)	0.100	0.112	0.112	0.112	0.132	0.414
Funding cost (%)	1.291	1.305	1.321	1.335	1.357	0.874
M/B	1.846	1.843	1.835	1.833	1.821	-0.338

Counterfactuals: Varying CBDC Rate

	(1) Zero rate	×FFR			(6) Sensitivity	
		(2) 25%	(3) 50%	(4) 75%	(5) Pays FFR	
CBDC Share	0.076	0.099	0.139	0.209	0.313	1.000
Transaction deposits	0.513	0.498	0.474	0.433	0.374	-0.585
Savings deposits	0.255	0.250	0.239	0.216	0.189	-0.278
Loan	1.007	1.003	1.001	0.975	0.942	-0.271
Cash	0.062	0.060	0.057	0.053	0.047	-0.063
Deposit spread (%)	1.092	1.078	1.060	1.014	0.965	-0.536
Loan spread (%)	2.189	2.185	2.186	2.202	2.203	0.061
Bank CDS spread (%)	0.132	0.143	0.147	0.374	0.625	2.054
Funding cost (%)	1.357	1.396	1.470	1.635	2.104	3.147
M/B	1.821	1.795	1.724	1.511	1.184	-2.682

Summary

- ▶ Effect on lending three times smaller than the effect on deposits
- ▶ The main margin of substitution is wholesale funding
 - ▶ Estimated frictions related to borrowing via wholesale funding are small ($r_N - f$)
 - ▶ Insured deposits allow banks to have a low default probability despite high leverage
- ▶ The effect on aggregate credit is even smaller
 - ▶ Firms substitute into bonds with high elasticity (≈ 0.9)

Impact on Bank Lending: Big vs. Small

		Small Banks	Big Banks
Panel A: Subsample Parameter Estimates			
ϕ^N	External financing cost	0.040	0.011
W_0	Relative size of the deposit base	0.390	0.328
ϕ^d	Bank's cost of taking deposits	0.012	0.011
ϕ^l	Bank's cost of servicing loans	0.006	0.006
χ	Net operating cost	0.196	0.108
Panel B: Impact of Introducing CBDC			
	Deposit-CBDC sensitivity	-0.602	-0.675
	Loan-CBDC sensitivity	-0.407	-0.146
	Funding cost-CBDC sensitivity	1.533	0.852

- ▶ In aggregate: one dollar increase in CBDC reduces deposits by 67 cents, loans by 30 cents
- ▶ Effect on lending smaller than that of deposits, especially for big banks
- ▶ The main margin of substitution is wholesale funding

Consumer and producer surplus

- ▶ CBDC **benefits depositors** by expanding their product space and forcing banks to pay high rates
- ▶ CBDC can **hurt borrowers** by reducing bank credit supply
 - What is the relative magnitude?

$$\underbrace{16.5}_{\text{Depositor surplus}} - \underbrace{1.9}_{\text{Borrower surplus}}$$

Consumer and producer surplus

- ▶ CBDC **benefits depositors** by expanding their product space and forcing banks to pay high rates
- ▶ CBDC can **hurt borrowers** by reducing bank credit supply
 - What is the relative magnitude?

$$\underbrace{16.5}_{\text{Depositor surplus}} - \underbrace{1.9}_{\text{Borrower surplus}} - \underbrace{9.5}_{\text{Bank surplus}} = \underbrace{5.1}_{\text{Net Surplus}}$$

- ▶ CBDC also **decreases the banking sector** surplus
- * Caveat: not a comprehensive welfare analysis, but a good starting point for major stakeholders

Implications for Bank Stability

- ▶ Without CBDC, 1 pp monetary policy shock leads to a -2% bank stock return
 - ▶ Banks with market power charge interest-sensitive deposit spreads
 - ▶ Deposit rate is less interest-sensitive and has an effectively long repricing maturity
- ▶ Magnitude increases by 3 fold when CBDC is introduced
 - ▶ Funding costs become more interest-sensitive, which effectively shortens liability duration
 - ▶ Greater effective maturity mismatch with long-term assets

Conclusion

- ▶ Provide a framework to quantify the impact of CBDC on banks' depository services, credit provision, and cyclical behaviors?
- ▶ Several channels:
 - ▶ Lowers deposit base
 - ▶ Reduces market power
 - ▶ Lowers profit
 - ▶ Increases funding costs

Berry, Steven, James Levinsohn, and Ariel Pakes, 1995, Automobile prices in market equilibrium, *Econometrica* 63, 841–90.

Koont, Naz, 2022, Digital banking, Working paper.