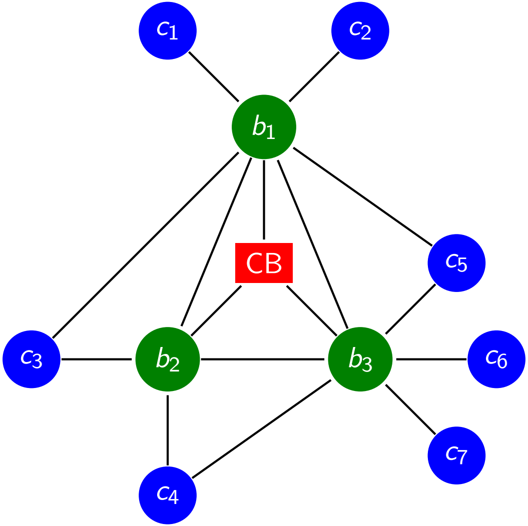
Digital currency policy economics

Part 3: Impact on bank credit provision

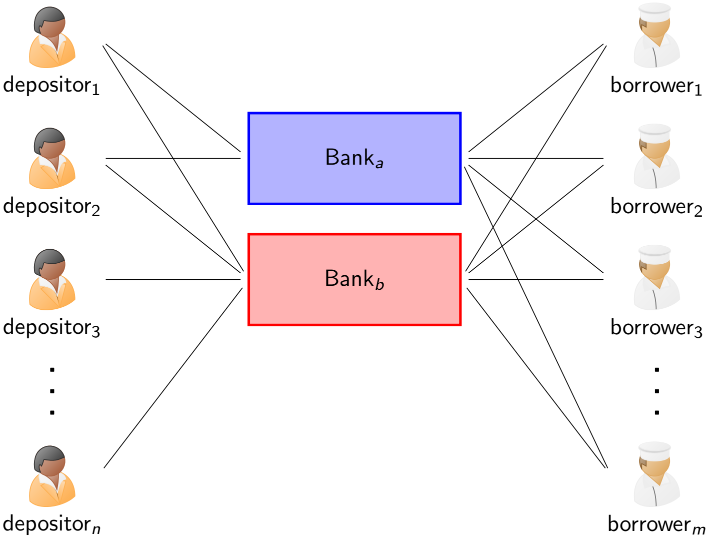
Darrell Duffie
Stanford Graduate School of Business

The Swedish House of Finance
Doctoral Course Program in Finance
June, 2022

Bank payment rails

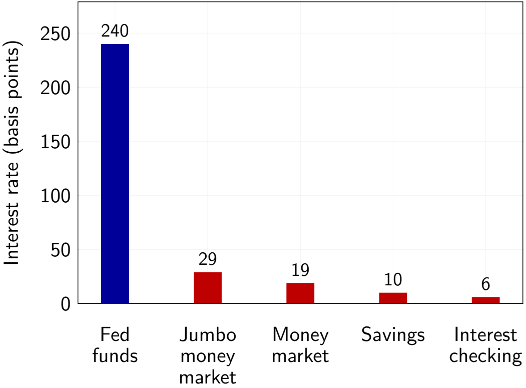


Banks fund borrowers with deposits and other funding



Weak competition for deposits reduces bank funding costs

When wholesale rates last peaked in April 2019



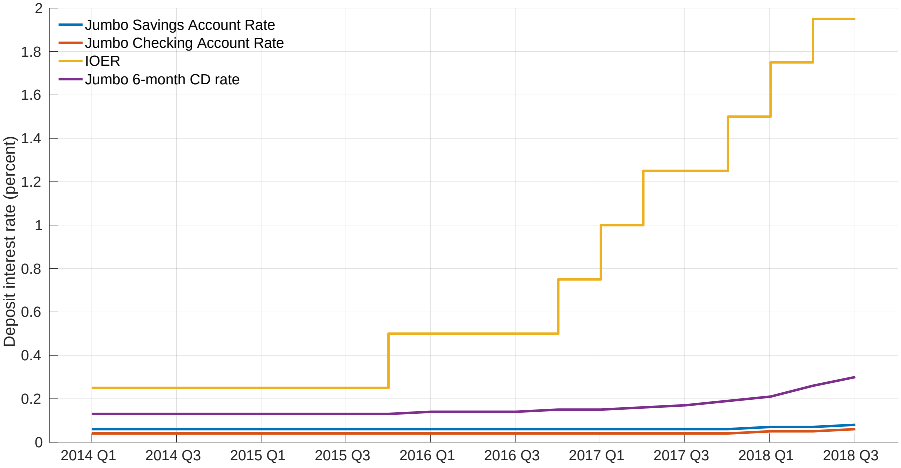
Data sources: FRED and FDIC.

Central banks are worried about credit provision

"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 for households and businesses." *Money and Payments: The U.S. Dollar in the Age of Digital Transformation,* Federal Reserve, 2022.

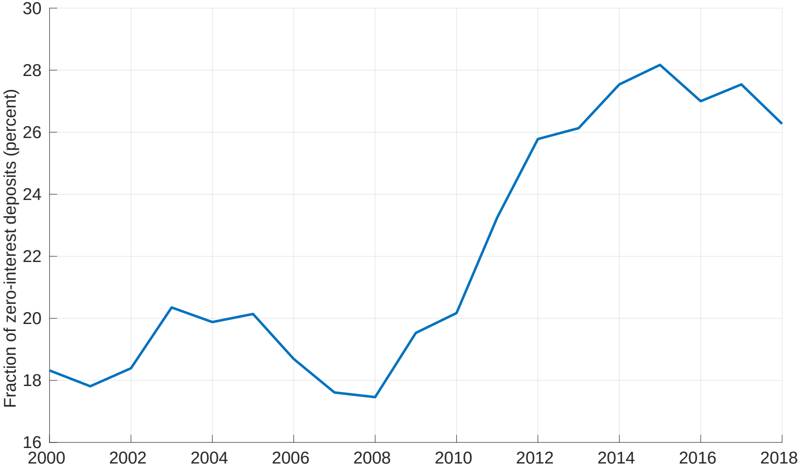
The BIS and G7 central banks, including the Fed, suggest that "if banks begin to lose deposits to CBDC over time they may come to rely more on wholesale funding, and possibly restrict credit supply in the economy with potential impacts on economic growth." *Central Bank Digital Currencies: Foundational Principles and Core Features,'* BIS, 2020.

U.S. banks do not offer competitive rates for retail deposits



Data sources: U.S. Federal Reserve and Federal Deposit Insurance Corporation.

A large fraction of U.S. bank deposits earn no interest



Data source: U.S. Federal Deposit Insurance Corporation.

A monopolistic bank with only deposit funding

1. Quantity q of deposits is raised at total interest expense $C(q)$.

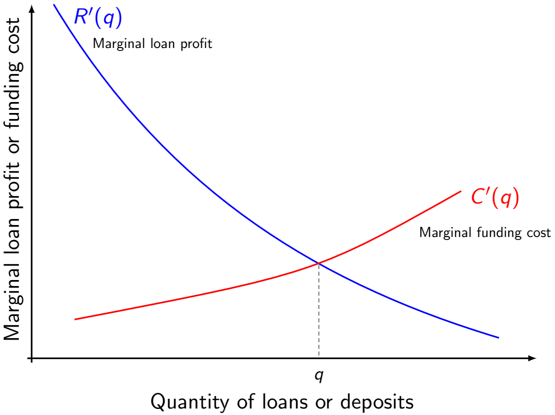
2. Quantity q of loans is made at total interest revenue $R(q)$.

3. The bank solves

$$\max_{q} \quad R(q) - C(q).$$

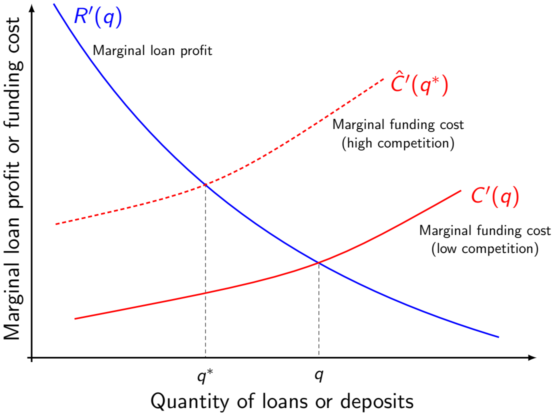
4. First order necessary condition for optimality: $R'(q) = C'(q)$.

A monopolistic bank that funds all loans with deposits

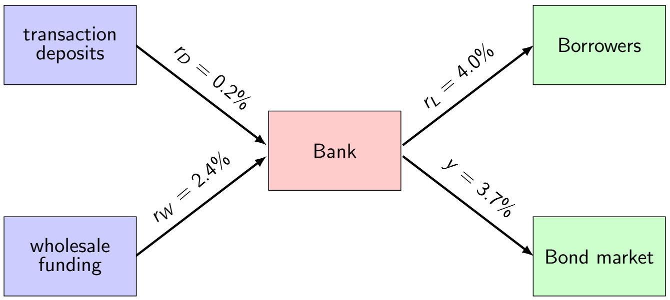


For small monopolistic banks:

Loan provision declines as deposit-market competition rises



CBDC-induced deposit-market competition is unlikely to lower credit provision much for large banks



References: Andalfatto (2020); Chiu, Davoodalhosseini, Jiang and Zhu (2021); Keister and Sanchez (2021); Whited, Wu, and Xiao (2022).

A condensed summary of Whited, Wu, and Xiao (2022)

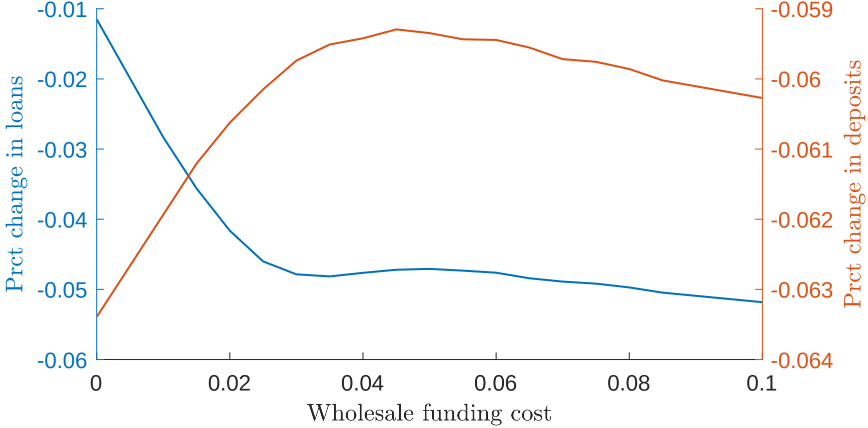
- Bank profit: $\max_{r^\ell, r^d} \; r^\ell L - r^d D - f(L-D)$, where $f(x)$ is the cost of wholesale funding.
- Household i solves $\max_j \; \alpha_i^d r_j^d + \beta_i^d x_j + \epsilon_{ij}^d$, where j is a choice from a discrete set of instrument types, including cash, short-term bonds, CBDC, saving deposits, and transaction deposits, for each bank.
- Similarly, firm i solves $\max_j \; \alpha_i^\ell r_j^\ell + \beta_i^\ell x_j + \epsilon_{ij}^\ell$.
- Banks solve a dynamic programming problem of optimal rate choices, defaulting when equity value reaches zero.
- Wholesale funding is competitive. CBDC has perfect credit quality, high transactions services, zero interest rate. All markets clear.

WWX US calibration: Impact of introducing a CBDC

		Small Banks	Big Banks
Panel A: Subsample Parameter Estimates			
μ	Average loan maturity	3.76	3.35
ξ	Firesale discount	0.27	0.19
W_0	Relative size of the deposit market	0.211	0.272
ϕ^d	Bank's cost of taking deposits	0.008	0.009
ϕ^l	Bank's cost of servicing loans	0.011	0.006
χ	Net operating cost	0.112	0.046
Panel B: Impact of Introducing CBDC			
Total deposits		-5.76%	-6.42%
Marginal fuding cost		+0.13%	+0.06%
Loans		-4.59%	-1.51%

Source: Whited, Wu, and Xiao (2022).

WWX US calibration: Impact of introducing a CBDC



Source: Whited, Wu, and Xiao (2022).

A search model in which banks post rates

The wholesale cost of funds of bank i is $c_i = c + \epsilon_i$, where c is common, ϵ_i is idiosyncratic.

The borrow rate p_i offered by bank i has an equilibrium probability distribution F that depends on c and ϵ_i

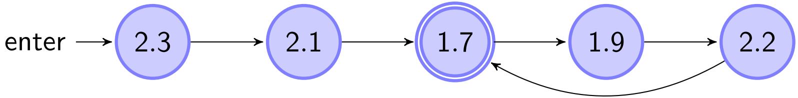
The payoff of bank i is $(p_i - c_i)Q_i$, where Q_i is the total volume borrowed.

References: Stahl (1989), Duffie, Dworczak, and Zhu (2019).

Fast borrowers pick the minimum rate offered

All borrowers value funding at some constant value v.

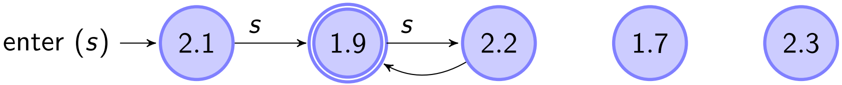
A fraction μ of borrowers are "fast," that is, have no search cost.



In this example, the payoff of the fast borrower is $v - 1.7$.

Feasible search path of an entering slow borrower

Slow borrowers visit banks in random order, facing a Pandora Problem.

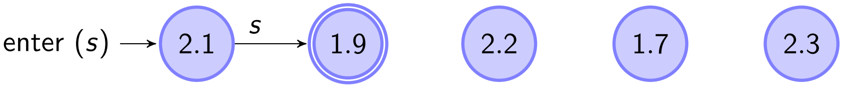


The net payoff of this path is $v - 1.9 - 3s$

Equilibrium search of a slow borrower

Enter with a probability λ_c.

Immediately accept the first offer below an optimal reservation rate r_c.



The net payoff of this path is $v - 1.9 - 2s$.

Simplifying

The support of the distribution of c is $[\underline{c}, \overline{c}]$.

We examine behavior on the event $\{c < v - s\}$. (Otherwise, slow borrowers don't enter and banks compete à la Bertrand, offering to lend at c.)

The unique equilibrium probability distribution F of offer quotes has no atoms and has upper support limit r_c.

Bank rate quote strategy

For a bank, the probability that a quote-observing borrower is fast is

$$q(\lambda_c) = \frac{\mu}{\mu + \frac{1}{N}\lambda_c(1-\mu)}.$$

Banks are indifferent between all rate offers in the support of F, so

$$\left[1 - q(\lambda_c) + q(\lambda_c)(1 - F(p))^{N-1}\right](p - c) = [1 - q(\lambda_c)]\,(r_c - c).$$

Solving,

$$F(p) = 1 - \left[\frac{\lambda_c(1-\mu)}{N\mu}\,\frac{r_c - p}{p - c}\right]^{\frac{1}{N-1}}.$$

Slow borrower strategy

Pandora solution of Weitzman (1979): Indifference to search when observing the quote r_c implies that

$$v - r_c = v - s - \mathbb{E}_F(p).$$

Solving,

$$r_c = c + \frac{1}{1-\alpha(\lambda_c)} s,$$

where

$$\alpha(\lambda_c) = \int_0^1 \left(1 + \frac{N\mu}{\lambda_c(1-\mu)} z^{N-1}\right)^{-1} dz < 1.$$

An interior entry probability λ_c solves

$$s = (1-\alpha(\lambda_c))(v-c).$$