

Credit Risk to NBFIs, Liquidity Risk to Banks:

A Conceptual Framework

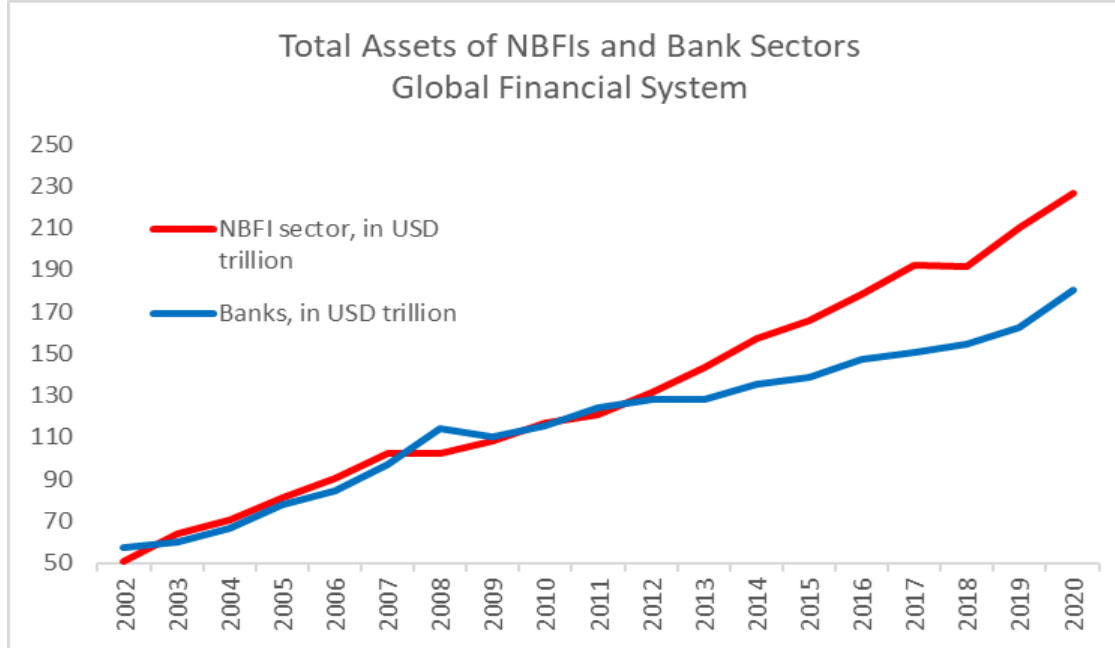
Viral V. Acharya, Nicola Cetorelli and Bruce Tuckman

June 2026

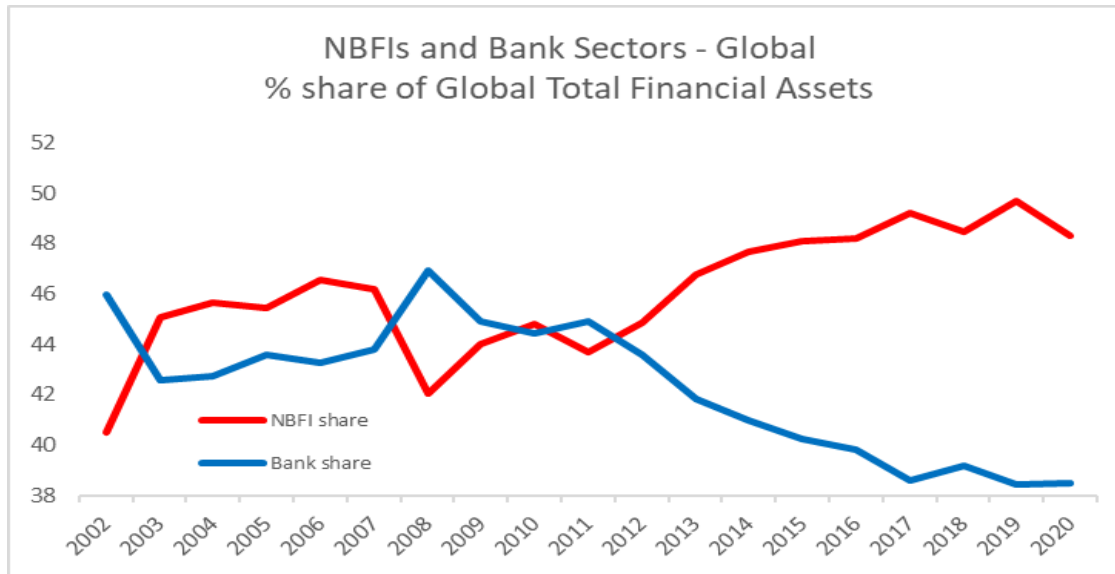
Disclaimer: The views expressed here do not necessarily reflect those of the Federal Reserve Bank of New York or the Federal Reserve System.

Motivation

Spectacular growth of NBFIs and ...



... (Apparent) Domination over banks post GFC



Are Non-Bank Financial Intermediaries (NBFIs) Displacing Banks and Becoming Truly Dominant in Financial Intermediation?

Source: Financial Stability Board (2022)

Standard views explaining NBFI growth

■ Parallel view

- Banks do intermediation (deposit-taking and credit extension)
- NBFIs provide other financial services (investment vehicles, risk management, trading, market making)
- Let them be. Keep them separate (e.g., Volcker 2009)

■ Substitution view

- NBFIs replacing banks as intermediaries
- Shift regulatory focus on NBFIs (e.g., Metrick and Tarullo (2021)'s “Congruence Principle”)

We have proposed instead a *Transformation* view

Acharya, Cetorelli and Tuckman (2025 - *RCFS*, 2026 – *JF I&P*):

- Banks are not dying... They are transforming their business model/risks
- Much of NBFIs activities, and their growth, require bank support
- Folly to understand NBFI growth in isolation from banks
- Significant systemic implications from their symbiotic relationship
 - Underestimation of banks' true risk exposures, especially under stress
 - Underappreciation of risk propagation/amplification channels in Banks & NBFIs

Credit risk to NBFIs, Liquidity risk to banks

1. Tightening of post-GFC bank regulations

- Higher regulatory cost for on-b/s riskier activities
- Capital requirements but also living wills



2. Banks have natural liquidity advantage as intermediaries

- Exclusive access to official backstops
- Stable deposit funding and liquidity risk management
- Post-GFC liquidity requirements: larger liquidity pools



Transformation View

Intermediation trans-forms endogenously

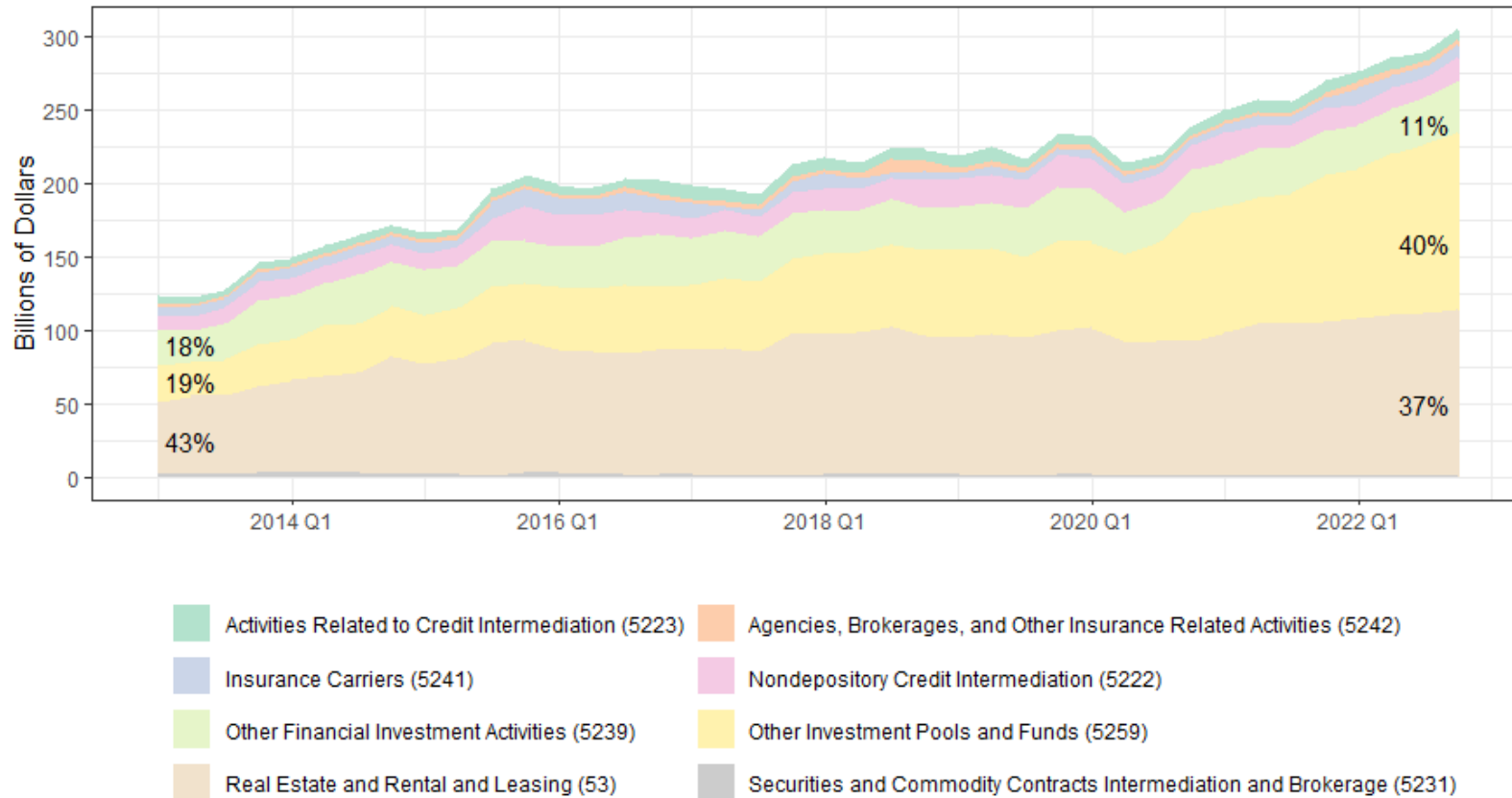
i) to warehouse credit risk at NBFIs to loosen regulatory constraints/ reduce regulatory costs;

ii) to harness the funding and liquidity advantages of bank deposit franchises and access to safety nets.

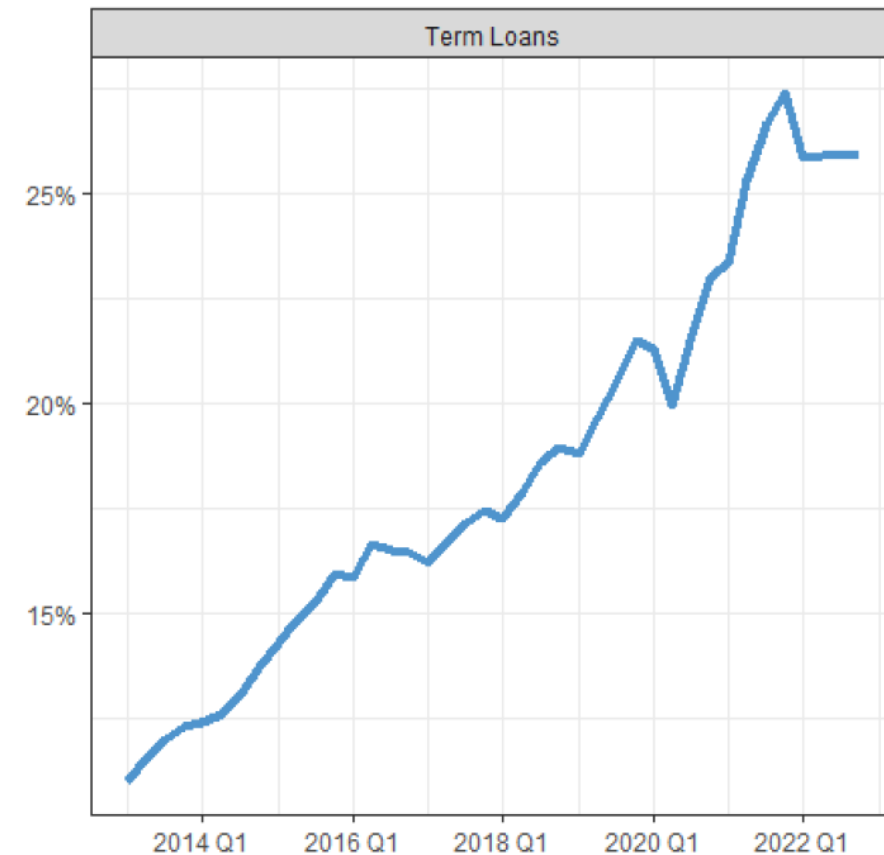
Large Increase of Bank Loans to NBFIs post GFC

Source: FR Y-14Q

Term Loan Committed Exposure by NAICS



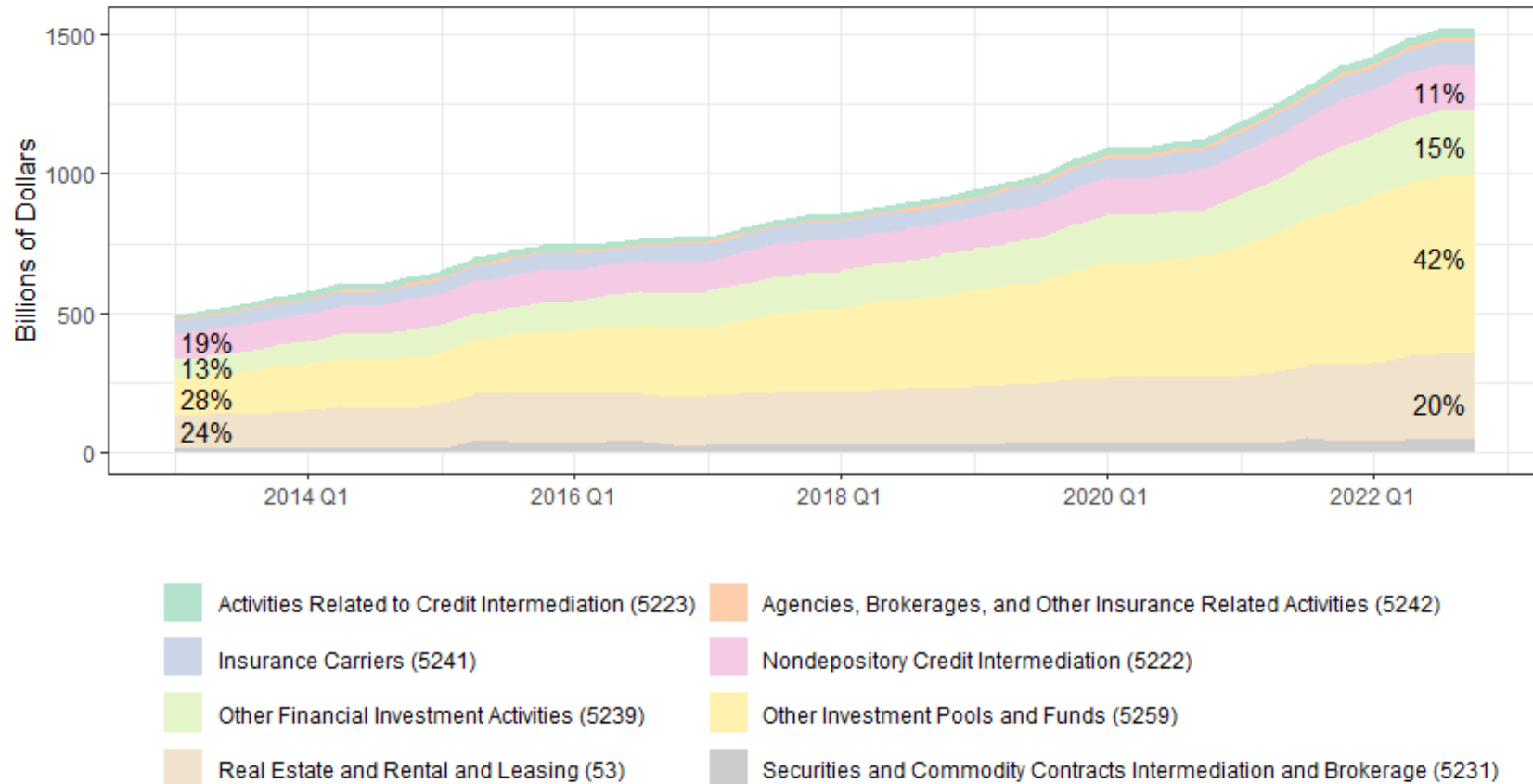
NBFI loans as share of total bank loans



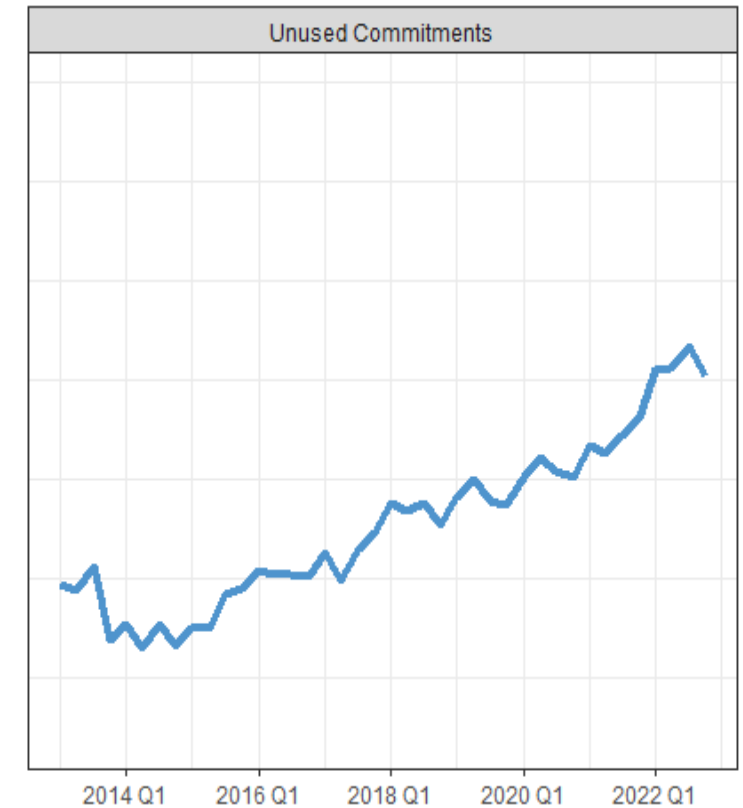
Large Increase in Credit Lines to NBFIs as well

Source: FR Y-14Q

Credit Line Committed Exposure by NAICS

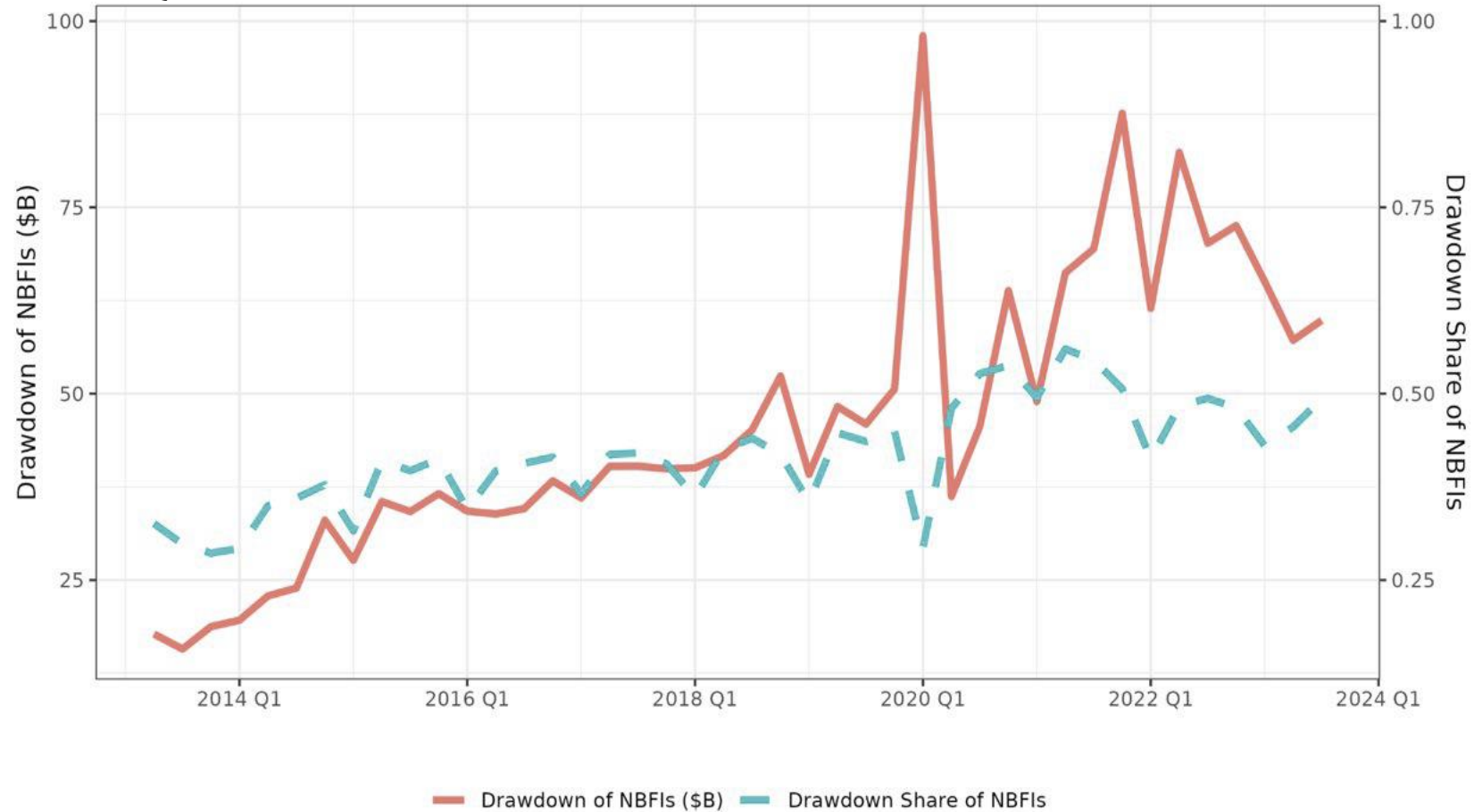


NBFI credit lines as share of total bank credit lines



Rising Share of Credit Line Drawdowns by NBFIs

Source: Form FR Y-14Q, Schedule H.1



Model of this "Transformation" View of Bank-NBFI Risks

■ Observations:

- Junior credit risk migrates to NBFIs.
- Senior credit risk stays with banks.
- Contingent liquidity (credit lines) flows from banks to NBFIs.

■ **This paper...** provides a theoretical foundation for this transformation

- Subordination by an NBFI helps relax bank capital requirements.
- Subordination incurs a deadweight cost as NBFI funding (or ownership) of assets leads to liquidity risk.
- Bank provides contingent liquidity to manage the liquidity risk of the NBFI.
- Regulator raises capital requirement level when financial stability costs outweigh economic activity.
- Subordination by NBFIs grows when financial stability costs outweigh economic activity (due to higher capital requirements)
- Contingent liquidity provision by banks to NBFIs raises the desirable level of bank capital requirements.

The Model

Three Key Assumptions

1. Bank funding advantage

- Cheap, stable deposits vs. costly equity (deposit franchise, official backstops).

2. Bank contingent liquidity advantage

- Banks can always raise liquidity in stress; NBFIs cannot.
- NBFIs' liquidity needs arise from contingent support to ultimate borrowers.
 - Examples: borrower liquidity provision in private credit, payment advances/forbearance in mortgage servicing, margin-call liquidity provision in commodity trading firms.

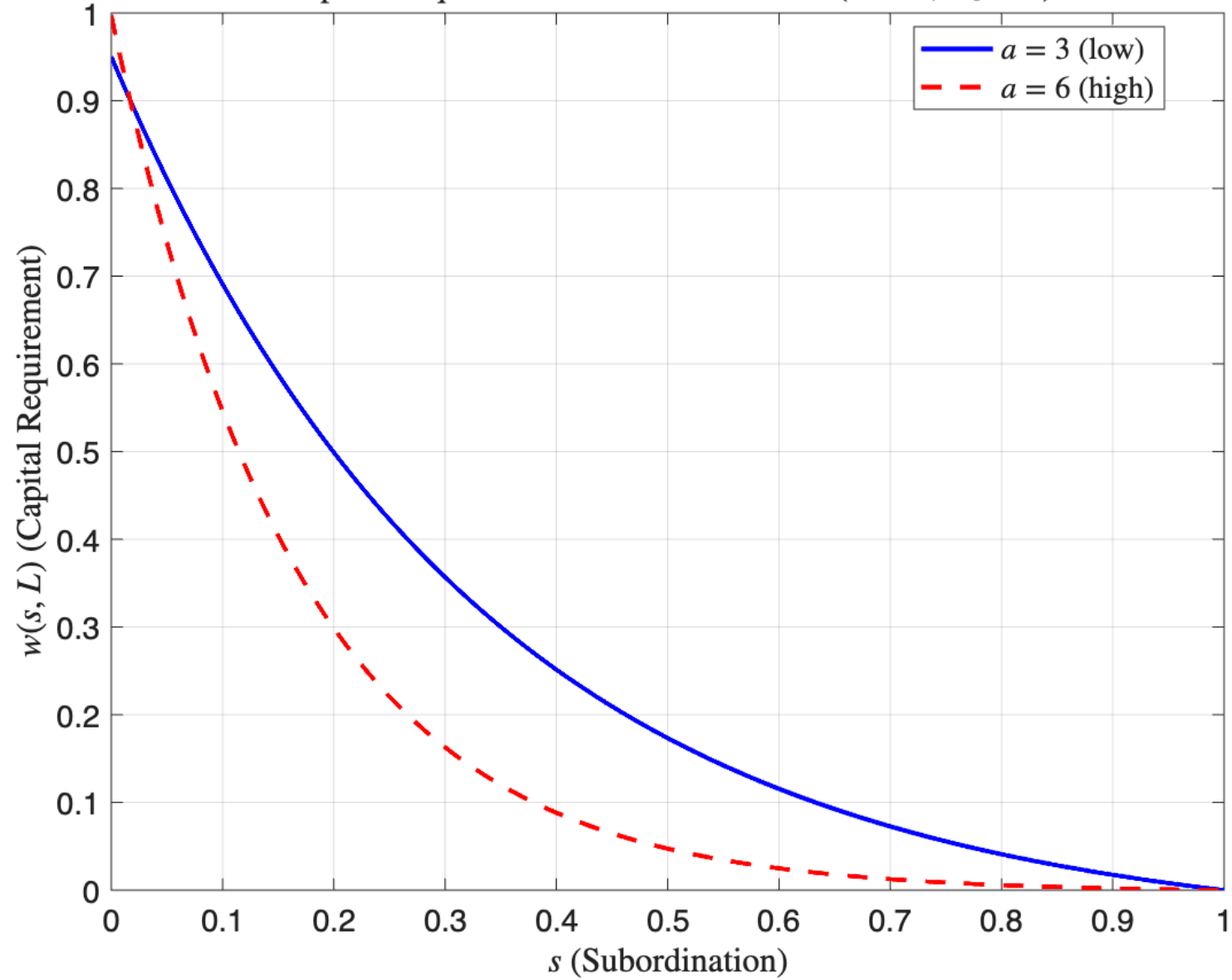
3. Coarse capital requirements

- Applied to banks (not NBFIs); trade off bailout cost vs. economic activity.
- Lack adequate sensitivity to subordination and credit lines.

Key Assumption 3: Coarse Capital Requirements

- Capital requirement $w(s, L)$ on each loan:
 - Falls with subordination s ; rises with credit line L .
- **Coarse:** lacks “adequate” sensitivity to subordination and credit lines.
- **Regulatory arbitrage:** subordination unlocks more cheap deposit funding.
- Functional form: $w(s, L) = w_0[e^{-as} - (1 - L)e^{-a}]$
 - w_0 is the level of capital requirements, a is a **fixed** parameter that describes how subordination and credit lines decrease and increase required capital, respectively.
 - Our results are robust to alternative functional forms of capital requirements, e.g., $w(s, L) = w_0(as^2 + bs + c + dL)$ subject to parameter restrictions that preserve all the desired properties.

Capital Requirement vs. Subordination ($L = 0, w_0 = 1$)



Setup: Four Dates, Four Agents, Three Choices

- **Four agents:** regulator, bank, NBFi, depositors.
- **Four dates:**
 - $t = 0$: regulator sets bank capital requirements.
 - $t = 1$: bank funds a unit loan (deposits, equity, junior tranche).
 - $t = 2$: possible liquidity shock; NBFi may draw the credit line.
 - $t = 3$: loan pays off (R_u) or defaults (R_d); possible depositor bailout.
- **Bank's three alternative financing choices:**
 - No subordination.
 - Subordination with credit lines.
 - Subordination without credit lines.
- **Regulator's capital requirement choice:**
 - Level of capital requirements w_0 (takes the shape "a" as given).

Balance Sheets of Bank and NBFI

- Bank originates the loan and securitizes it to the NBFI.
- Bank asset: the unit loan.
- Funded by deposits + equity + a junior tranche held by the NBFI.
- Losses absorbed in order: junior (NBFI) tranche, then equity, then deposits.
- A drawn-and-defaulted credit line erodes the buffer (s to $s - L$)... If $s = L$, from s to 0.

Bank Originates Loan

w/o Credit Line or w/ Undrawn Credit Line

Before Loan Realization

Bank		NBFI	
Assets	Liabilities	Assets	Liabilities
Loan: 1	Jr. Tranche: s	Jr. Tranche: s	Equity: s
	Deposits: $1 - s - w(s, L)$		
	Equity: $w(s, L)$		

Loan Default, Wiping Out Jr. Tranche

Bank		NBFI	
Assets	Liabilities	Assets	Liabilities
Loan: $1 + R_d$	Jr. Tranche: 0	Jr. Tranche: 0	Equity: 0
	Deposits: $1 - s - w(s, L)$		
	Equity: $R_d + s + w(s, L)$		

w/ Drawn Credit Line $L \leq s$ to Meet Redemptions of Limited Partners

Before Liquidity and Loan Realizations

Bank		NBFI	
Assets	Liabilities	Assets	Liabilities
Loan: 1	Jr. Tranche: s	Jr. Tranche: s	Equity: $s - L$
Credit Line: L	Deposits: $1 - s - w(s, L)$		Credit Line: L
	Fed Loan: L		
	Equity: $w(s, L)$		

NBFI Cannot Raise New Equity; Defaults on Credit Line; and Loan Defaults

Bank		NBFI	
Assets	Liabilities	Assets	Liabilities
Loan: $1 + R_d$	Jr. Tranche: 0	Jr. Tranche: 0	Equity: 0
Credit Line: 0	Deposits: $1 - s - w(s, L)$		Credit Line: 0
	Fed Loan: L		
	Equity: $R_d + s - L + w(s, L)$		

NBFI Originates Loan

w/o Credit Line or w/ Undrawn Credit Line

Before Loan Realization

Bank		NBFI	
Assets	Liabilities	Assets	Liabilities
Sr. Tranche: $1-s$	Deposits: $1 - s - w(s, L)$	Loan: 1	Sr. Tranche: $1-s$
	Equity: $w(s, L)$		Equity: s

Loan Default, Wiping Out NBFI Equity

Bank		NBFI	
Assets	Liabilities	Assets	Liabilities
Sr. Tranche: $1+R_d$	Deposits: $1 - s - w(s, L)$	Loan: $1+R_d$	Sr. Tranche: $1+R_d$
	Equity: $R_d + s + w(s, L)$		Equity: 0

w/ Drawn Credit Line $L \leq s$ to Support Borrowing Firm

Before Liquidity and Loan Realizations

Bank		NBFI	
Assets	Liabilities	Assets	Liabilities
Sr. Tranche: $1-s$	Deposits: $1 - s - w(s, L)$	Loan: $1+L$	Sr. Tranche: $1-s$
Credit Line: L	Fed Loan: L		Credit Line: L
	Equity: $w(s, L)$		Equity: s

NBFI Cannot Raise New Equity; Defaults on Credit Line; and Loan Defaults

Bank		NBFI	
Assets	Liabilities	Assets	Liabilities
Sr. Tranche: $1+R_d$	Deposits: $1 - s - w(s, L)$	Loan: $1+R_d$	Sr. Tranche: $1+R_d$
Credit Line: 0	Fed Loan: L		Credit Line: 0
	Equity: $R_d + s - L + w(s, L)$		Equity: 0

Timing, State-Space & Payoffs

▪ If the loan pays off:

- Junior Tranche: $s(1 + C)$
 - s : principal, C : coupon rate.
- Depositors: $(1 - s - w(s, L))(1 + \beta r_f - y + \theta)$
 - β : deposit beta, r_f : risk free rate, y : convenience yield, θ : depositor-required spread.
- Bank: residual claimant.

▪ If the loan defaults:

- The regulator's bailout policy, parameterized by ϕ , provides protection to bank depositors only after both the junior tranche and the bank's equity have been fully exhausted.
- Depositors: ϕ of their principal at par + $1 - \phi$ of their principal at the residual value of the bank.
- **No subordination:** bank equity takes first loss.
- **Subordination + credit line:**
 - Severe shock: NBFI defaults on line, bank takes first loss.
 - Moderate / no shock: NBFI takes first loss.
- **Subordination, no line + shock:** loan always defaults (deadweight loss).

- Three outcomes: loan pays off; loan defaults (bank first loss); loan defaults (NBFI first loss).

Financing Decision

**No
Subordination**
Jr Tranche: 0
Bank Equity: $w(0,0)$
Depositors: $1-w(0,0)$

**Subordination
w/ Credit Lines**
Jr Tranche: s
Bank Equity: $w(s,L)$
Depositors: $1-s-w(s,L)$

**Subordination
w/o Credit Lines**
Jr Tranche: s
Bank Equity: $w(s,0)$
Depositors: $1-s-w(s,0)$

Liquidity Realization

Bank and loan unaffected by any
liquidity shock.

Severe liquidity shock: NBFI draws
down and defaults on credit line.

Moderate liquidity shock: NBFI
draws down and repays credit line.

No liquidity shock

No liquidity shock

Liquidity shock: NBFI cannot
support borrower / loan defaults.

Loan Realization

Loan pays off
OR
Loan defaults;
**Bank equity takes
1st loss**

Loan pays off
OR
Loan defaults;
NBFI takes 1st loss

Loan defaults;
NBFI takes 1st loss

Financing Decision

No Subordination
 Jr Tranche: 0
 Bank Equity: $w(0,0)$
 Depositors: $1-w(0,0)$

Subordination w/ Credit Lines
 Jr Tranche: s
 Bank Equity: $w(s,L)$
 Depositors: $1-s-w(s,L)$

Subordination w/o Credit Lines
 Jr Tranche: s
 Bank Equity: $w(s,0)$
 Depositors: $1-s-w(s,0)$

Liquidity Realization

Bank and loan unaffected by any liquidity shock.

Severe liquidity shock: NBFI draws down and defaults on credit line.

Moderate liquidity shock: NBFI draws down and repays credit line.

No liquidity shock

No liquidity shock

Liquidity shock: NBFI cannot support borrower / loan defaults.

Loan Realization

Loan pays off
 OR
 Loan defaults;
Bank equity takes 1st loss

Loan pays off
 OR
 Loan defaults;
NBFI takes 1st loss

Loan defaults;
NBFI takes 1st loss

Claim	Loan Pays Off	Loan defaults: Bank equity takes 1 st loss	Loan defaults: NBFI takes 1 st loss
Jr Tranche	$s(1+C)$	L	0
Bank Equity	$1+R_u-s(1+C)-(1-s-w(s,L))\cdot(1+\beta r_f-\gamma+\theta)$	0	0
Depositors	$(1-s-w(s,L))\cdot(1+\beta r_f-\gamma+\theta)$	$\phi(1-s-w(s,L))+(1-\phi)(1+R_d-L)$	$\phi(1-s-w(s,L))+(1-\phi)(1+R_d)$
Government	0	$\phi(R_d+s+w(s,L)-L)$	$\phi(R_d+s+w(s,L))$
Total	$1+R_u$	$1+R_d$	$1+R_d$

Probability Space

- Loan pays off with p_u ; defaults with p_d .
- Liquidity shock occurs with p^l .
 - Severe shock (NBFI defaults on line): p_b .
 - Moderate shock (NBFI repays line): p_n .
- Identity: $p_b + p_n = p_d$
- Collapses to three outcome probabilities that sum to 1.

Financing Decision	Liquidity Realization	Loan Pays Off	Loan Defaults: Bank equity takes 1 st loss	Loan Defaults: NBFI takes 1 st loss	Notation
No Subordination Jr Tranche: 0 Bank equity: $w(0,0)$ Depositors: $1-w(0,0)$	Bank equity unaffected by any liquidity shock.	p_u	p_d		$p_u + p_d = 1$ $p_b + p_n = p_d$
Subordination w/ Credit Lines Jr Tranche: s Bank equity: $w(s,L)$ Depositors: $1-s-w(s,L)$	Severe liquidity shock: NBFI draws down and defaults on credit line. Moderate liquidity shock: NBFI draws down and repays credit line. No liquidity shock	$p^l p_u$ $(1 - p^l) p_u$	$p^l p_b$	$p^l p_n$ $(1 - p^l) p_d$	No Subordination: $\tilde{p}_u \equiv p_u$ $\tilde{p}_{db} \equiv p_d$ $\tilde{p}_{dn} \equiv 0$ Subordination w/ Credit Lines: $\tilde{p}_u \equiv p_u$ $\tilde{p}_{db} \equiv p^l p_b$ $\tilde{p}_{dn} \equiv p^l p_n + (1 - p^l) p_d$
Subordination w/o Credit Lines Jr Tranche: s Bank equity: $w(s,0)$ Depositors: $1-s-w(s,0)$	No liquidity shock Liquidity shock: NBFI cannot support borrower / loan defaults.	$(1 - p^l) p_u$ 0		$(1 - p^l) p_d$ p^l	Subordination w/o Credit Lines: $\tilde{p}_u \equiv (1 - p^l) p_u$ $\tilde{p}_{db} \equiv 0$ $\tilde{p}_{dn} \equiv (1 - p^l) p_d + p^l$

Bank's Optimization Problem

Choose subordination s and credit line L to maximize equity profit

$$\max_{s, L} \pi(s, L) = \tilde{p}_u \left[1 + R_u - s(1 + C) - (1 - s - w(s, L))(1 + \beta r_f - y + \theta) \right]$$

- Fair pricing condition for deposit spread θ

Bailouts affect bank profits via deposit spread

$$\begin{aligned} & \tilde{p}_u(1 - s - w(s, L))(1 + \beta r_f - y + \theta) \\ & + \tilde{p}_{dn}[\phi(1 - s - w(s, L)) + (1 - \phi)(1 + R_d)] \\ & + \tilde{p}_{db}[\phi(1 - s - w(s, L)) + (1 - \phi)(1 + R_d - L)] \\ & = (1 - s - w(s, L))(1 + \beta r_f - y) \end{aligned}$$

- Fair pricing condition for tranche coupon C

$$\tilde{p}_u s(1 + C) + \tilde{p}_{db} L = s(1 + r_f)$$

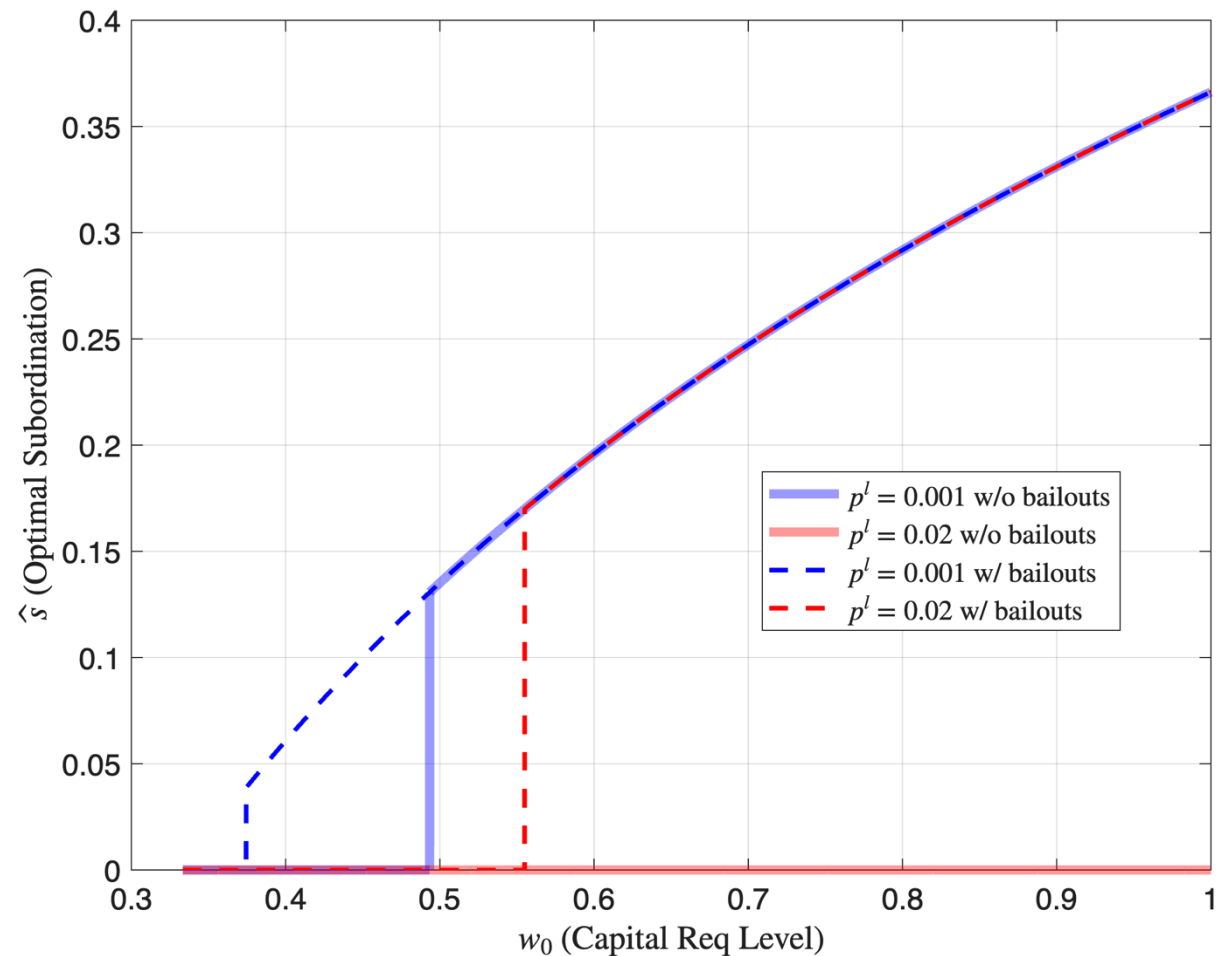
Bank's Optimization Problem

- **Intuition:** maximize cheap deposit funding $1 - s - w(s, L)$ [foc: $w'(s, L) = -1$] ;
 - In general, an s -invariant $\bar{w}(s, L)$ is too complex and likely infeasible to implement.
- Bailouts reduce deposit spread, increasing the bank's profit when the loan pays off.
- Credit-line provision reduces junior-tranche coupon rate and restores the probability of the loan paying off, increasing the bank's profit when the loan pays off.
- Both credit lines and bailouts can ease subordination's deadweight loss.

Key Results

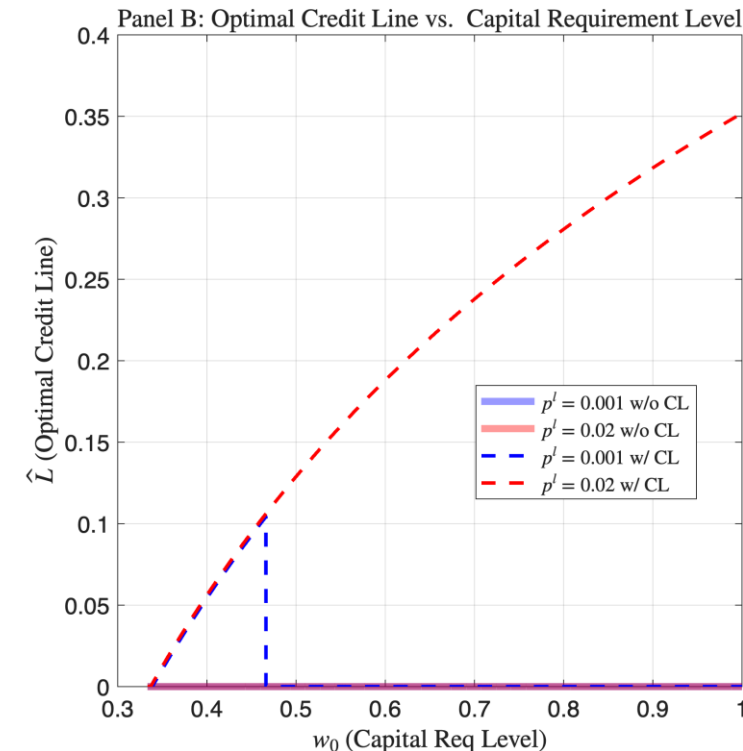
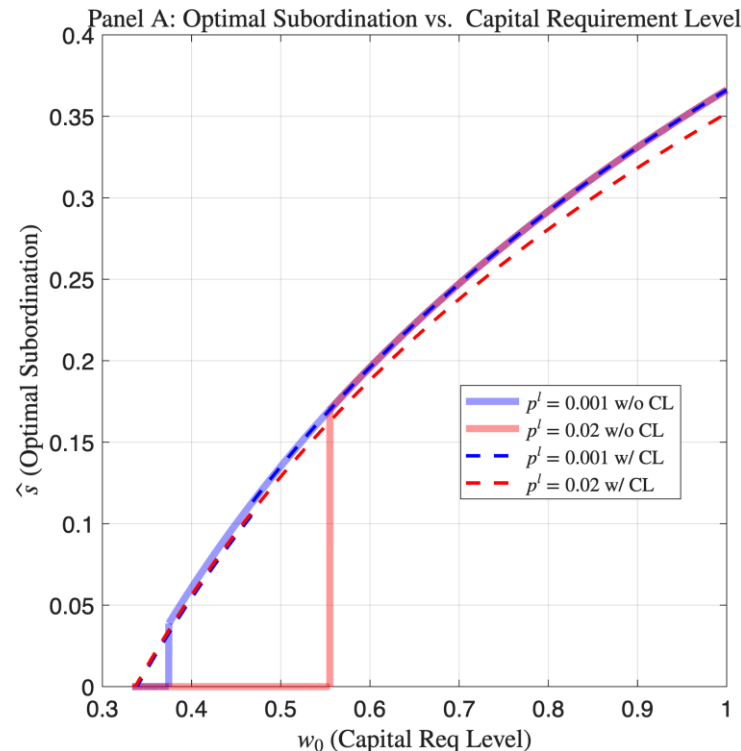
Subordination (NBFIs) Mirrors (Banks') Deposit-Seeking

- Without credit lines or bailouts, bank subordinates when p^l is low.
- A bailout makes it more likely for bank to subordinate.
- Higher capital requirement $w_0 \rightarrow$ more subordination.
 - Restores the bank's cheap deposit funding.



Credit Lines: Manage NBFIs risk, Transfer risk back

- Credit lines mitigate the deadweight loss of subordination.
 - NBFFI can support the borrower through a liquidity shock.
- Offered only when the NBFFI liquidity risk is high enough.
- Drawn-and-defaulted lines transfer credit risk back to banks.



Regulatory Problem

(shows subordination in equilibrium)

Regulator's Optimization Problem

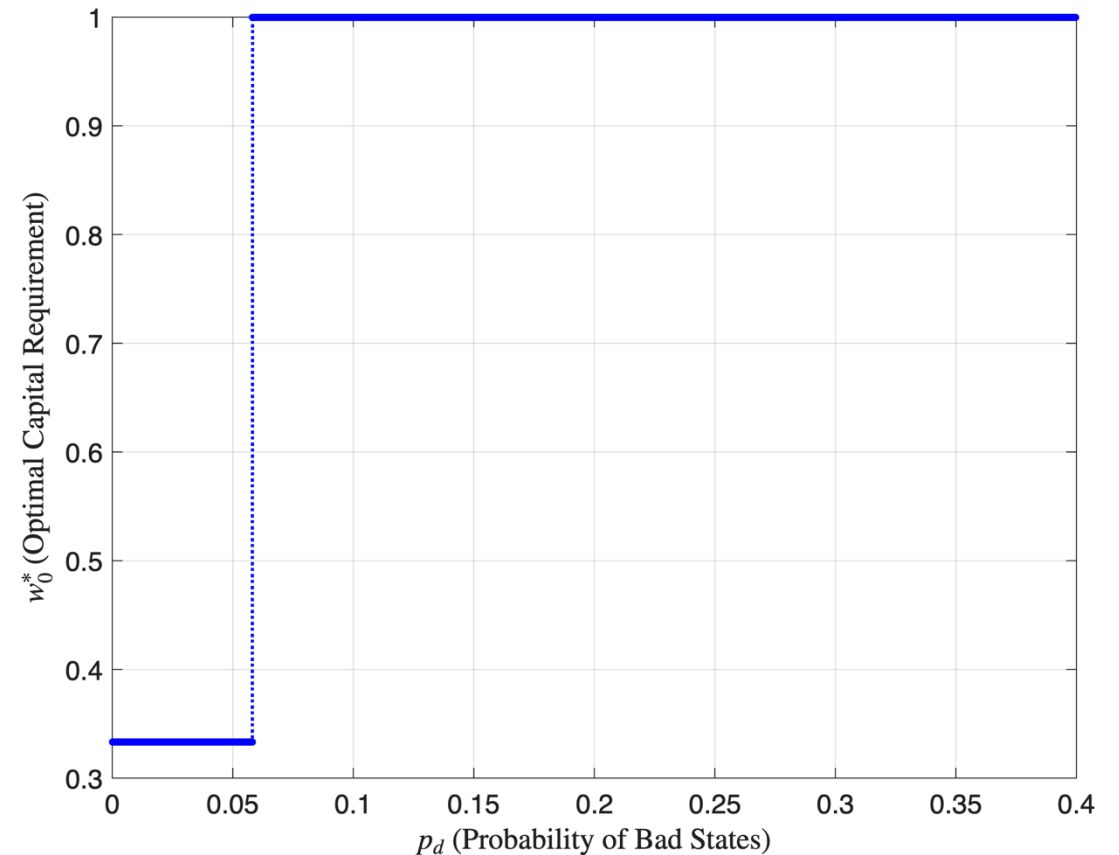
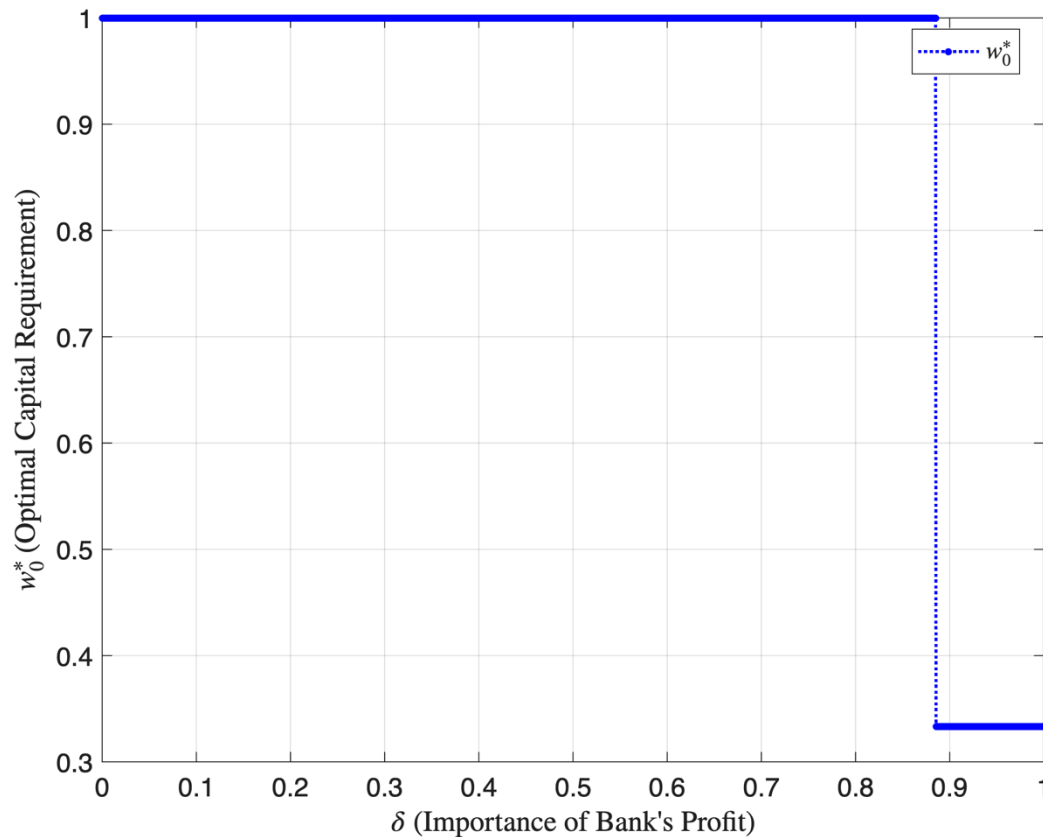
Choose the capital level w_0 (taking the shape α as given)

$$\max_{w_0} \pi^R = P_1 \left[\delta \pi_1 + \phi \tilde{p}_d (R_{d1} + w(\hat{s}, \hat{L}) + \hat{s}) - \phi \tilde{p}_{db} \hat{L} \right] \\ + (1 - P_1) \left[\delta \pi_2 + \phi \tilde{p}_d (R_{d2} + w(\hat{s}, \hat{L}) + \hat{s}) - \phi \tilde{p}_{db} \hat{L} \right]$$

- P_1 : The probability of the “usual” state of loan outcome.
- Objective: $\delta \times$ expected bank profit – expected bailout size;
Constraint: one w_0 for all states (no state-contingent capital).
- **Intuition:** low w_0 (encourage growth); high w_0 (limit bailouts).

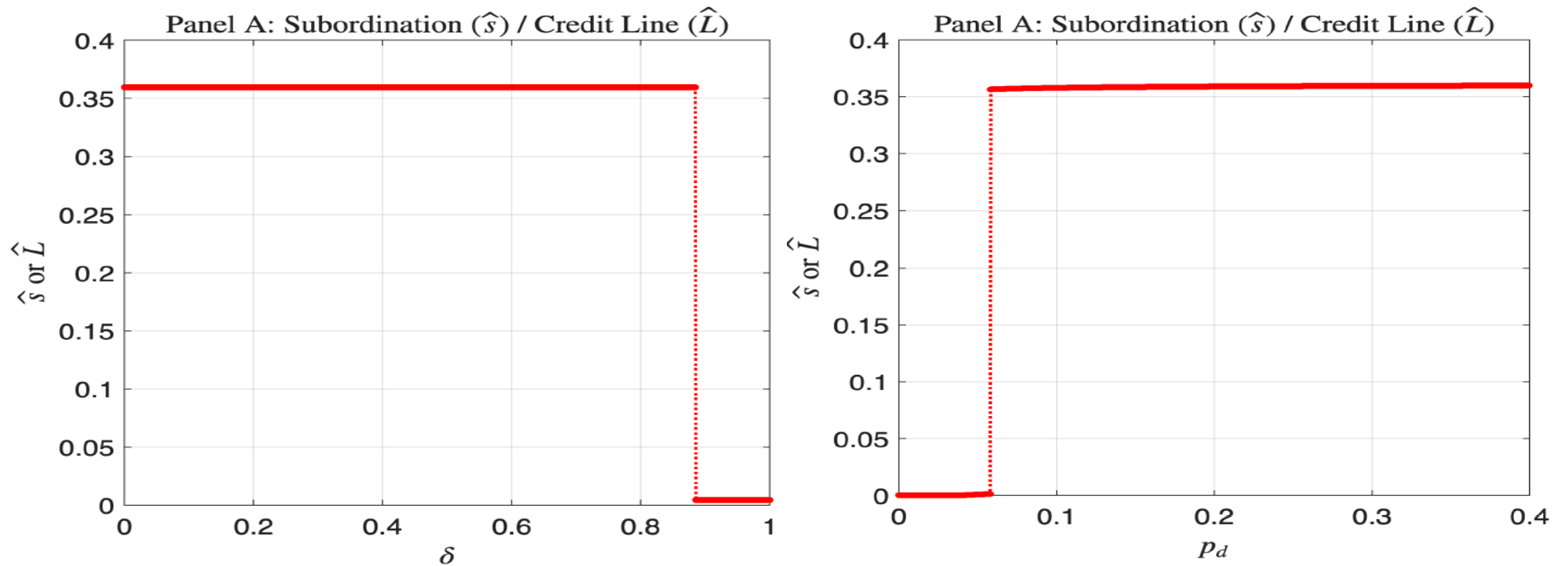
Optimal Capital Requirements: Growth vs. Bailouts

Higher growth weight, lower probability of loan default $\rightarrow$ lower capital



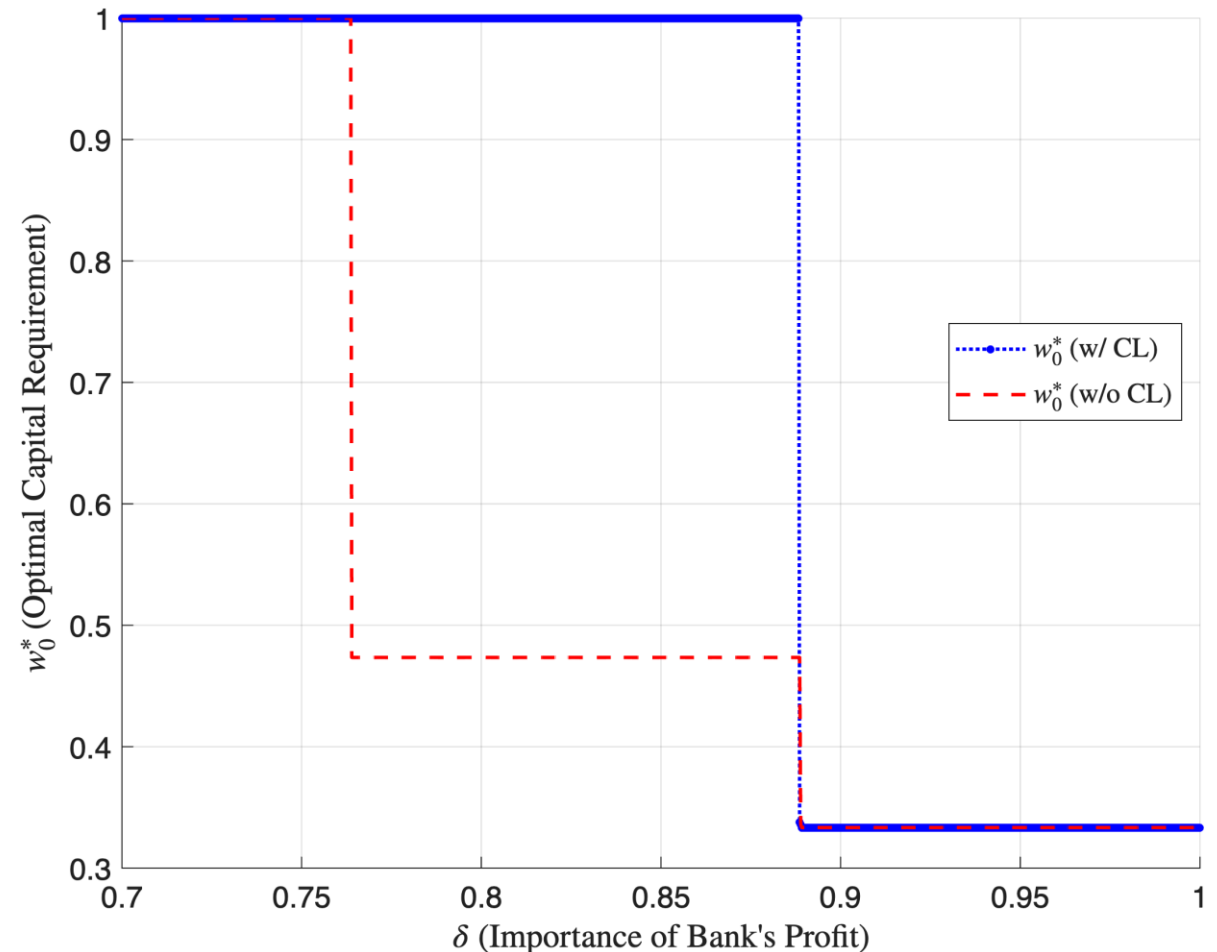
Subordination an equilibrium outcome

Higher capital requirements $\rightarrow$ More subordination to NBFIs



Optimal Capital Requirements: w/ and w/o Credit Lines

- Divergence between capital requirements with and without credit-line provision:
- Credit-line provision transfers credit risk back to bank → Large bailout costs in severe liquidity shock.



Conclusion: Key Takeaways

A theoretical foundation for risk transformation between banks and NBFIs:

- Credit risk to NBFIs: subordination to NBFIs helps relax bank capital requirements.
 - Bank's funding advantage from deposits.
- Liquidity risk to banks: bank provides contingent liquidity to NBFIs.
 - Bank's contingent liquidity advantage.
- Credit lines manage deadweight loss of subordination to NBFIs, but transfer credit risk back to banks.
- Coarse capital requirements trade off economic activity vs. bailout cost.
- Contingent liquidity to NBFIs can raise the desirable level of bank capital.

Conclusion: Future Directions for Research

- Interest-rate cycle and cyclicalities of subordination.
 - In low-rate periods, the convenience yield on deposits rises, the NBFI sector grows, and that growth is backed by more bank credit lines.
 - This presumes bank capital requirements don't move at the same time — TRUE?
- An interim period and encumbrance costs of drawn credit lines.
 - Interim stage between an NBFI's drawdown and the eventual loan payoff.
 - Loan losses need *not* actually materialize for NBFI stress to migrate onto bank balance sheets and reach the real economy; provisioning may encumber capital when loan losses rise?
- Implications for stress testing.
 - When and how different types of NBFIs draw on credit lines? Implications for bank capital.

Related Literature

Related Literature

- Bank's liquidity provision:
 - Kashyap, Rajan, and Stein(2002), Yankov (2020), Acharya, Gopal, Jager, and Steffen (2024), Xu (2025), Metrick and Tarullo (2022)

- Bank regulation and boundaries of intermediation:
 - Plantin (2015), Huang (2018), Farhi and Tirole (2021), Begenau and Landvoigt (2022)

Related Literature

- Empirics of riskier credit migration:
 - Nonbanks step into bank's role: Irani, Iyer, Meisenzahl, and Peydro (2021), Jang (2026)
 - Features of nonbank lending: Chernenko, Erel, and Prilmeier (2022),

- Bank-NBFI funding:
 - NBFIs as transformed intermediation: Acharya, Cetorelli, and Tuckman (2024, 2025),
 - Private credit and banks: Chernenko, Ialenti, and Scharfstein (2024), Haque, Jang and Wang (2025)
 - Mortgage companies and credit lines: Kim, Laufer, Pence, Stanton, and Wallace (2018), Benson, Kim, and Pence (2023)
 - Reasons for bank-NBFI coexistence: Donaldson, Piacentino, and Thakor (2021), Lyonnet and Chretien (2026), Cetorelli, Cisternas, and Sarkar (2025), Cetorelli and Prazad (2024)