Peer Monitoring via Loss Mutualization

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Motivation

Extensive bailout plans in response to the financial crisis....

- US Treasury disbursed \$313 bn to financial industry through TARP.
- Euro Area governments incurred net cost of €178 bn in asset relief programs, recapitalizations, guarantees, etc.

...pushed governments to pass legislation aimed at reducing *future* bailout costs on taxpayers.

Policy response

Financial sector should bear a higher share of losses:

- Bank resolution funds (Dodd Frank Title II, BRRD)
- Mandatory clearing via CCPs (Dodd Frank Title VII, EMIR)
- European Deposit Insurance Scheme? (under discussion)

Current loss mutualization schemes share an 'atomistic' perspective:

- Contributions to loss sharing funds proportional to bank riskiness.
- Different mix of *prefunded* and *ex post* contributions.
- Focus exclusively on *loss absorption capacity* in case of default.

Idea

Main idea: loss mutualization may be used as a tool to allocate losses in a way that fosters **peer discipline** among banks.

Main model ingredients:

- Banks subject to moral hazard.
- Banks have **superior skills** to assess other banks' credit risk and they trade in an interbank market.
- Each bank knows the identity of its counter parties in the interbank market (OTC market).

Main results

Q&A on optimal loss sharing design to enhance peer discipline:

- ▷ How shall we distribute losses (beyond the defaulter's contributions) among surviving banks?

  Allocate losses only to banks exposed to the defaulter.

- ▷ How large should be optimal contributions?

  Reduce bank shareholders payoff to zero.

- ▷ Less effective when banks face less credit risk from their exposures?

  Irrelevant under optimal scheme. Otherwise, higher contagion risk favours peer discipline.

- ▷ Role of costly prefunded resources ('skin in the game')?

  They substitute and reinforce peer discipline.

Literature

- Peer monitoring: Stiglitz (1990), Varian (1990), Ghatak (2000).
- Interbank discipline: Rochet & Tirole (1996), De Young et al. (1998), Peek et al. (1999), Furfine (2002).
- CCPs: Biais et al. (2012b), Antinolfi et al. (2014), Zawadowski (2013).

Model

▷ *Players:* N (even) identical banks & a competitive sector of investors. Universal risk neutrality.

▷ *Timing*: $t = 0, 1, 2, 3$.

▷ *Investment Technology*

- Pay $I > 0$ at $t = 0$ and receive 0 (with prob d_i) or $R > 0$ at $t = 3$.
- d_i is realized at $t = 2$ and depends on the effort choice at $t = 1$:
  - ⋆ Effort costs $c > 0$ and it leads to $d_i = d$ with prob. $\alpha \geq 0$ or $d_i = 0$.
  - ⋆ Without effort $d_i = d$.

  where $d \backsim G(\cdot)$ is common to all banks and has expected value m.
- If $k \leq N$ banks exert effort, the probability that l are 'safe' is given by a correlated binomial pmf $\mathbb{P}_k(l)$ with $\sum_{l=0}^{k} \mathbb{P}_k(l) \frac{k-l}{k} = \alpha$.
- Effort decisions are **not observable**.

Model

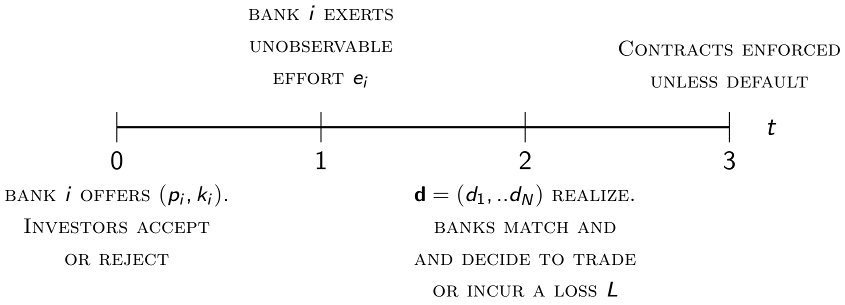
▷ *Investors' contract at $t = 0$.* Bank i offers a contract (p_i, k_i):

- p_i is the amount to reimburse at $t = 3$.
- k_i is a pre-payment at $t = 0$ and it costs $\mu > 1$ per unit.
- Final payoff at $t = 3$: $\pi_i = R - p_i + k_i$

▷ *Interbank market at $t = 2$*

- At $t = 2$ all banks observe $\mathbf{d} = (d_1, ..., d_N)$ and simultaneously decide to match with another bank.
- Banks can only enter a *bilateral* transaction with another bank:
  - ⋆ Trading avoids a loss $L > 0$...
  - ⋆ ...but increases default risk: $d_i + (1 - d_i)d_j \gamma$

Timing



▷ I restrict attention to **symmetric subgame perfect** equilibria.

Interbank market

- Common knowledge of $(d_1, ..., d_N)$. Final payoff π_i determined at $t = 0$.
- Bank i payoff displays *strong monotonicity* with respect to d_i, d_j:

$$(1 - d_i)(1 - d_j\gamma)\pi_i$$

1. *Threat of ostracism*

   Bank i accepts to trade with bank j only if:

$$(1 - d_i)(1 - d_j\gamma)\pi_i \geq (1 - d_i)\pi_i - L \quad \rightarrow \quad d_j \leq \frac{L}{(1 - d_i)\gamma\pi_i}$$

   For simplicity, I consider parameters s.t. two risky banks trade for all d.

2. *Endogenous self-selection and positive assortative matching*

   Suppose l banks are safe and $N - l$ are risky. In a stable matching:

   - If l is even, all pairs include banks of identical credit risk.
   - If l is odd, all pairs include banks of identical credit risk except one.

Effort Choice - Matching Probabilities

- If all N banks exert effort, the probability p_j at $t = 1$ (effort decision) is:

$$p_{ss} = \sum_{l=0}^{N} \mathbb{P}_N(l) \frac{l}{N} \left[\mathbb{I}_{\{\text{l even}\}} + \left(1 - \frac{1}{l}\right) \mathbb{I}_{\{\text{l odd}\}} \right] = 1 - \alpha - \frac{1}{N} \sum_{l=0}^{N} \mathbb{P}_N(l) \mathbb{I}_{\{\text{l odd}\}}$$

$$p_{rr} = \sum_{l=0}^{N} \mathbb{P}_N(l) \frac{N-l}{N} \left[\mathbb{I}_{\{\text{l even}\}} + \frac{N-l-1}{N-l} \mathbb{I}_{\{\text{l odd}\}} \right] = \alpha - \frac{1}{N} \sum_{l=0}^{N} \mathbb{P}_N(l) \mathbb{I}_{\{\text{l odd}\}}$$

$$p_{rs} = p_{sr} = \frac{1}{N} \sum_{l=0}^{N} \mathbb{P}_N(l) \mathbb{I}_{\{\text{l odd}\}}$$

- Focus on $N \to \infty$ case, hence $p_{rs} = p_{sr} = 0$.

- Let q_{rs} be the probability that, after shirking, a risky bank matches with a safe bank, assuming the other $N - 1$ banks exerted effort.

$$q_{rs} = \sum_{l=0}^{N-1} \mathbb{P}_{N-1}(l) \frac{1}{N-l} \mathbb{I}_{\{\text{l odd}\}}$$

- *Perfect correlation:* $q_{rs} = 1 - \alpha$ *Independence:* $q_{rs} = 0$.

Effort Choice

▷ Exert effort:

$$\mathbb{E}_{e_i=1}[u_i|\pi] = p_{ss}\pi_i + p_{rr}\left[\int_0^1 (1-x)(1-\gamma x)g(x)\,\mathrm{d}x\right]\pi_i - c$$

▷ Shirk:

$$\mathbb{E}_{e_i=0}[u_i|\pi] = (1-m)\pi_i - q_{rs}\left[1 - G\left(\frac{L}{\gamma\pi_j}\right)\right]L - \pi_i\gamma(1-q_{rs})\int_0^1 x(1-x)g(x)\,\mathrm{d}x$$

▷ Incentive compatibility constraint:

$$\pi_i \geq \frac{c - q_{rs}\left[1 - G\left(\frac{L}{\gamma\pi_j}\right)\right]L}{m(1-\alpha) + \gamma(1-\alpha-q_{rs})\int_0^1 x(1-x)g(x)\,\mathrm{d}x} := \xi(\pi_j) \qquad \text{(IC)}$$

▷ If 'involuntary' credit risk depends exclusively on:

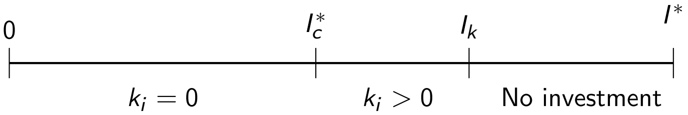
- *Macro shock*: $q_{rs} = 1-\alpha$ $\rightarrow$ **Threat of ostracism**
- *Idiosyncratic factors:* $q_{rs} = 0$ $\rightarrow$ **Endogenous self-selection**

Incentive Compatible Contract

- First best max investment $I^* = sR - c$ (s prob. of surviving)
- Incentive compatible contract.

$$
\begin{aligned}
\max_{p_i, k_i} \quad & s(R - p_i + k_i) - \mu k_i - c \\
\text{s.t.} \quad & R - p_i + k_i \geq \xi(\pi_j) \qquad \text{(IC)} \\
& s p_i + (1 - s) k_i \geq I \qquad \text{(IR)}
\end{aligned}
$$

- IC equilibrium:



Loss Mutualization Scheme

- ▷ All N banks participate to the loss sharing scheme. I exclude the possibility to reward a bank.
- ▷ In case of a bank's default, its investors may receive payments from other banks at $t = 3$.
- ▷ Investors are risk-neutral and transfers only serve for incentives.
- ▷ Loss sharing contributions can be interpreted as *penalties*.
  - τ_0: penalty if a bank did not trade with any bank.
  - τ_1: penalty if bank traded with a defaulter.
- ▷ No penalties on banks which traded with a non-defaulting peer. Otherwise, more stingent IC constraint but no welfare improvement.
- ▷ Positive assortative matching continues to hold.

Loss Mutualization Scheme

▷ Focus on $N \to +\infty$ case. Ex-ante probability to trade is one.

$$\pi_i \geq \frac{c - q_{rs}\left[1 - G\left(\frac{L}{\gamma\pi_j + (1-\gamma)\tau_1 - \tau_0}\right)\right]L - \tau_1(1 - q_{rs} - \alpha)(1-\gamma)\int_0^1 x(1-x)g(x)\,\mathrm{d}x}{m(1-\alpha) + \gamma(1 - q_{rs} - \alpha)\int_0^1 x(1-x)g(x)\,\mathrm{d}x}$$

▷ Transfers affect the IC constraint via both peer discipline mechanisms:

- *Threat of ostracism*: $q_{rs}\left[1 - G\left(\frac{L}{\gamma\pi_j + (1-\gamma)\tau_1 - \tau_0}\right)\right]L$
- *Endogenous self-selection*: $\tau_1(1 - q_{rs} - \alpha)(1-\gamma)\int_0^1 x(1-x)g(x)\,\mathrm{d}x$

Loss Mutualization Scheme

- Let s and z be the prob. to survive and to pay τ_1.
- Max program:

$$\begin{aligned} \max_{p_i,k_i} \quad & s(R - p_i + k_i) - \mu k_i - z\tau_1 - c \\ \text{s.t.} \quad & R - p_i + k_i \geq \xi(\pi_j, \tau_0, \tau_1) && \text{(IC)} \\ & sp_i + (1-s)k_i + z\tau_1 \geq I && \text{(IR)} \end{aligned}$$

- For a given (τ_0, τ_1) the max investment levels are:

$$\begin{aligned} I_c^* = & \quad I^* - s\xi(R - \tfrac{I - z\tau_1}{s}, \tau_0, \tau_1) + c + z\tau_1 \\ I_k = & \quad I^* - \tfrac{\mu - 1}{\mu}\left[s\xi(\pi_\tau, \tau_0, \tau_1) + c + z\tau_1\right] \end{aligned}$$

where π_τ solves $\pi = \xi(\pi, \tau_0, \tau_1)$.

Optimal Loss Mutualization Scheme

Proposition

The optimal loss contributions are $\tau_0 = 0,\ \tau_1 = \pi_c^*$, where π_c^* is the solution to $\pi = \xi(\pi, 0, \pi)$.

- Impose the highest penalty on *shareholders* **only if** a bank has previously traded with a defaulter.
- Importance of punishing informed counter parties. In bilateral interbank market it occurs via direct losses.
- Under the optimal scheme the IC constraint is γ **independent**:

$$\pi \geq \frac{c - q_{rs}\left[1 - G\left(\frac{L}{\pi}\right)\right]L}{m(1-\alpha) + (1-\alpha-q_{rs})\int_0^1 x(1-x)g(x)\,\mathrm{d}x}$$

Extension I

Information acquisition

- Immediately after exerting effort banks have to decide whether to pay a cost $c_d > 0$ to observe other banks default proababilities.
- Set up a plausible microfoundation of the matching process. Out-of-equilibrium, a bank with no information on others' credit risk has to match with informed counter parties.
- IC constraint for information acquisition is:

$$c_d \leq (1-\alpha)(1-\mathbb{E}[n_s|d_i = 0])m(\gamma\pi_i + (1-\gamma)\tau_1)$$

Extension II

Interbank collateral

- Extend model with a loss distribution and the possibility to post costly collateral to other banks at $t = 2$.
- Interbank collateral reduces the threat of ostracism. A risky bank uses collateral to 'bribe' a safe bank and reduce its loss given default.
- Crucial difference between collateral posted to investors before effort choice, and to other banks once a bank becomes risky.

Limitations

- A more realistic framework should include many interbank counter parties, different bank sizes, and multiple financial contracts available.
- With multiple bank relationships, how should we measure a 'closer' bank relationship?
- Difficult to punish bank shareholders as much as possible.
  In a dynamic context a very high punishment may create future incentives for misconduct.
- Risk-sharing considerations may call for loss sharing contributions also from banks with no trading relationships with the defaulter.
  However, an 'unequal' distribution should still apply to foster peer discipline incentives.