# Fear of Fire Sales and the Credit Freeze by Diamond and Rajan (forthcoming, QJE)

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# Introduction

- Paper is about interbank and C&I lending freeze during crisis.
- Common explanations:
  - Asymmetric information across banks.
    - Extreme to cause full market shut-down.
  - Fear of Bank Run.
    - Resolved by lending facilities.
    - Banks did not use all lending facilities.

# In this paper...

- **Strategic behavior** by cash rich banks.
  - Distressed Banks $\rightarrow$ liquidate assets to meet demand.
  - Fire-sales $\rightarrow$ investment opportunity for solvent banks.
    - C&I lending may freeze $\rightarrow$ opportunity cost.
    - Interbank lending may freeze $\rightarrow$ low prices given future expected fire-sales.

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- **Strategic behavior** by cash rich banks.
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    - Fire-sales $\rightarrow$ investment opportunity for solvent banks.
        - C&I lending may freeze $\rightarrow$ opportunity cost.
        - Interbank lending may freeze $\rightarrow$ low prices given future expected fire-sales.
- **Moral-Hazard behavior** by illiquid funds.
    - Selling before trouble is social optimum.
    - Selling before trouble not be private optimum:
        - Why sell cheap today if bailed out tomorrow?
        - If problems tomorrow $\rightarrow$ limited liability + FDIC insurance.

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  - MH behavior.
- More structure.
  - To explain lending.

# Environment

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- Liquid banks:
  - Deep pockets.

# Liquidity Shock

- Fraction $f$ of deposits are recalled in $t = 1$.
- Probability $q$.
- Bank must sell assets to finance withdrawal.

# Financing Withdrawals

- Banks can sell assets at $t = 0$.
  - $P_o$ per unit of $Z$.
- Sell asset at $t = 1$ (conditional on shock).
  - $P_1$ per unit of $Z$.

# T=0 Financing Demand

- Indifference Condition to buy in $t = 0$:

$$\frac{1}{P_o}Z = q\frac{1}{P_1}Z + (1-q)\,Z$$

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- If $P_o > min(P_o^{bid}, 1)$ no lending.
- In equilibrium: $P_o \leq 1, P_1 \leq 1$.

# T=1 Financing Supply

- Infinitely elastic supply if $P_1 \leq 1$.

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\begin{aligned}
& q\left[\left(1-\eta_1\right) Z-(1-f) D\right]+(1-q)[Z-D] \\
= \; & Z-D-qfD\left(\frac{1}{P_1}-1\right)
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- $\left(\frac{1}{P_1} - 1\right)$ fire-sale loss.
- Assumption1: **Unlimited liability** or Always **Solvent.**

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- Time 0 sales: $\eta_0 Z P_0 \geq fD$.
- Payoff $t = 0$ selling.

$$(Z - D) - fD \left[ \frac{1}{P_0} - 1 \right]$$

- Recall Payoff $t = 1$ selling:

$$(Z - D) - qfD \left( \frac{1}{P_1} - 1 \right)$$

- Indifference condition:

$$P_o^{ask} = \frac{1}{q \frac{1}{P_1} + (1 - q)}$$

# Equilibria I

- Equilibrium is indeterminate.
  - $P_1 = P_0 = 1$.
  - Quantities indeterminate.
- Why?

# + Limited Liability

- Insolvency+Limited liability $\rightarrow$ only internal funds used.
- FDIC guarantees deposits.

## + Limited Liability

**Proposition**

*Under LL, bank is liquidated upon liquidity shock. Bank never sells in t=0 even if it may become solvent by selling at* $t = 0$*. No trade occurs at* $t = 0$*.*

- Why?

# More Structure

- Finite pockets: liquid banks $\theta$ amount of cash.
  - Opportunity cost $\rightarrow$ $I(R)$ downward sloping exogenous funds.
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  - Why? Induces interesting price effects.

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  - Why? Induces interesting price effects.
- Assume liquid banks can liquidate loans.
  - $\beta$ fraction of securities.
  - $(1-\beta)$ fraction of loans.
    - Face value is $Z$.
    - Liquidation values $x\tilde{}U[0, Z]$.
  - Why? insolvency.

# Timing

| Bank Type | | | |
|---|---|---|---|
| Illiquid Banks | Sell Securities | Loan Liquidation | Loans pay-off, dividends |
| Liquid Banks | Purchase of Securities, Loans or Cash | Purchase of Loans | Loans pay-off, dividends |
| | **t=0** | **t=1 (shocks arrive)** | **t=2** |

# Fire-sales

- Which loans are sold?
- Convenient for bank to sell assets with value $x \geq P_1 Z$.
- Thus, bank can raise:

$$\frac{1}{Z}\int_{P_1 Z}^{Z} x dx = \frac{Z}{2}\left(1 - (P_1)^2\right)$$

# Efficient equilibria

- Efficient Equilibria
- $\theta - \bar{I} = \theta - I(1) \geq fD \rightarrow P_1 = P_0 = 1.$

# Inefficient equilibria

- Inefficient equilibria: $\theta - \bar{I} < fD$.
- Date 1 cash needs:

$$(1-\beta)\frac{Z}{2}\left(1-(P_1)^2\right)+\left[\theta - I\left(\frac{1}{P_o}\right)\right] = fD$$

- Price indifference condition:

$$P_o^{Ask} = \frac{1}{q\frac{1}{P_1}+(1-q)}$$

- Conditions pin-down prices.
- Bank solvency:

$$(1-\beta)\,P_1 Z \cdot P_1 + (1-\beta)\frac{Z}{2}\left(1-(P_1)^2\right) + \beta P_2 Z > (1-f)\,DP_1 + fD$$

# Results

1. $\uparrow f, \uparrow D$ or $\downarrow \theta \rightarrow \downarrow P_0$ and $\downarrow P_1$.
2. $\uparrow q \rightarrow \downarrow P_0$ and $\uparrow P_1$.
3. $\uparrow f, \uparrow D$ ,$\uparrow q$ or $\downarrow \theta \rightarrow$ Time 0 lending.

# Bank Runs

- Assume that insolvency implies all agents withdraw $D$.

# Example Prices

# Example Lending