金融中介理论

第三讲：金融中介与流动性创造

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Content

- History of bank runs and bank panics
- Background: model of liquidity of insurance
- Instability and remedies
- Disciplinary role of bank runs
- Efficient bank runs: reconstruction
- Extension: interbank markets
- Systemic risk and contagion

History of bank runs and bank panics

- Bank runs vs. Bank panics?
  - Entity to be affected
  - Bank runs: one individual bank
  - Bank panics: whole banking market
- In U.S. history, bank panics are rather common
  - 1890-1908: 21 bank panics
    - 1893 crisis results in 500 bank failures
    - 1907 crisis results in 100 bank failures
  - 1929-1933: 5 bank panics
  - Foundation of the Fed, December 23, 1913
    - 1907 crisis averted by J. P. Morgan, who died on March 31, 1913

Why studying bank panics matters?

- From macroeconomics perspective:
  - GNP growth : 3.75 % to 6.82%
  - Liquidity shortage
  - Interference to monetary policy
- From individual perspective
  - Bankruptcy: prisoner's dilemma
  - Loss of confidence in government

核心文献

- Diamond, D. W., and P. H. Dybvig. 1983. Bank Runs, Deposit Insurance, and Liquidity. *Journal of Political Economy* 91:401–419.
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- Allen, F., and D. Gale. 1998. Optimal Financial Crises. *Journal of Finance* 53:1245–1284.
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Background: Model of Liquidity Insurance

- One homogenous good
- Three dates: $t = 0, 1, 2$
- A continuum of *ex ante* identical agents
  - i.i.d. liquidity shocks: patient (π_1) or impatient (π_2)
- Maximize expected utility:

$$U = \pi_1 u(C_1) + \pi_2 u(C_2)$$

Background: Model of Liquidity Insurance

- Illiquid storage technology
  - $R > 1$: return at $t = 2$
  - $l < 1$: return at $t = 1$
- Autarky: $C_1 = lI + 1 - I, C_2 = RI + 1 - I$
  - Time $t = 0$, choose of I
  - $C_1 < 1$ or $C_2 < R$

Optimal Allocation

- Optimal allocation problem:

$$\max U = \pi_1 u(C_1) + \pi_2 u(C_2)$$
$$\text{s.t. } \pi_1 C_1 = 1 - I$$
$$\pi_2 C_2 = RI$$

- F.O.C:

$$-u'({C_1}^*) + Ru'({C_2}^*) = 0$$

- Market solution: $C_1 = 1, C_2 = R, I = \pi_2, p = 1/R$
  - Bond market at $t = 1$, paying one unit of consumption good at $t = 2$, price p, so that $C_1 = pRI + 1 - I, C_2 = RI + \frac{1-I}{p} \Rightarrow pR = 1$
  - Not optimal
  - Asymmetric information

Fractional Reserve Banking System

- Contract with optimal withdrawal (C_1^*, C_2^*)
  - C_1^*: if impatient
  - C_2^*: if patient
- Amount of liquidity at $t = 1$: $1 - I = \pi_1 C_1^*$
- Amount of liquidity at $t = 2$: $RI = \pi_2 C_2^*$
- Banks: solvent with probability 1
  - Intuition: eliminate asymmetric information by pooling
- Wait. Something is missing. What?

Another Scenario

- What if patients expect other patients to be impatient?
  - Banks: forced to liquidate its investment
  - Total asset at $t = 1$: $\pi_1 C_1{}^* + (1 - \pi_1 C_1{}^*) l < C_1{}^*$
  - Bank runs happen: all depositors withdraw
- Stability in realization of the first equilibrium is yearned for!

Instability: Early Withdrawal

- Reason 1: higher outside return
  - $C_2^*/C_1^* - 1 < r$
- Reason 2: multiple equilibrium
  - Speculation about others' action
  - Institutional arrangements: needed to rule out the
    - inefficient equilibrium

Remedy No.1: Narrow Banking

- Case 1: repayment to all depositors using liquidity

$$C_1 \leq 1 - I, C_2 \leq RI$$

  - Dominated by autarky
- Case 2: liquidity fulfilled by liquidation

$$C_1 \leq (1 - I) + lI, C_2 \leq RI + 1 - I$$

  - Reduced to autarky
- Case 3: securitization of its long run technology
  - Same as market solution

Remedy No.2: Regulatory Responses

- Case 1: Suspension of Convertibility
  - Banks: not serve more than withdrawal $\pi_1 C_1^*$
  - Above the threshold: suspended convertibility
  - Kind of ideal and illegal
- Case 2: Insured depositors
  - Repayment guaranteed by another intuition

Remedy No.3: Equity Financed Banks

- A dividend d: announced to be distributed at $t = 1$
  - Amount of d: determined ex ante at $t = 0$
  - Reserves of d and investment $(1 - d)$
- Shares of bank
  - Traded during period 1 (time point matters!)
  - One share: ensures a right to consumption $R(1 - d)$
  - Equilibrium price p: depends on d

Remedy No.3: Equity Financed Banks (Cont.)

- Take d and p as given
- Impatient agents: sell shares and consume at $t = 1$
  - $C_1 = d + p$
- Patient agents: wait at $t = 1$ and consume at $t = 2$
  - $C_2 = \left(1 + \frac{d}{p}\right) R(1 - d)$
- Price determined through stock market clearing
  - $\pi_1 = \pi_2 \frac{d}{p} \Rightarrow p = \frac{\pi_2 d}{\pi_1}$

Remedy No.3: Equity Financed Banks (Cont.)

- The equilibrium price yields

$$C_1 = \frac{d}{\pi_1}, C_2 = \frac{R(1-d)}{\pi_2}$$

- This is equivalent to

$$\pi_1 C_1 + \pi_2 \frac{C_2}{R} = 1$$

Remedy No.3: Equity Financed Banks (Cont.)

- Reduced to optimal allocation
- Variability in d
  - More freedom in term structure
  - Room for Pareto improvement to market economy

Disciplinary Role of Bank Runs

- Renegotiation: trigger bank runs potentially
- Bargaining power of banks: limited
- Lead to higher level of financing

Simple Model: Renegotiation Proof

- Opportunity cost: 1 for excess of savings
- Entrepreneurs: project but no cash
- Two periods: $t = 1, 2$
- Financiers: cash but no project

Simple Model: Renegotiation Proof (Cont.)

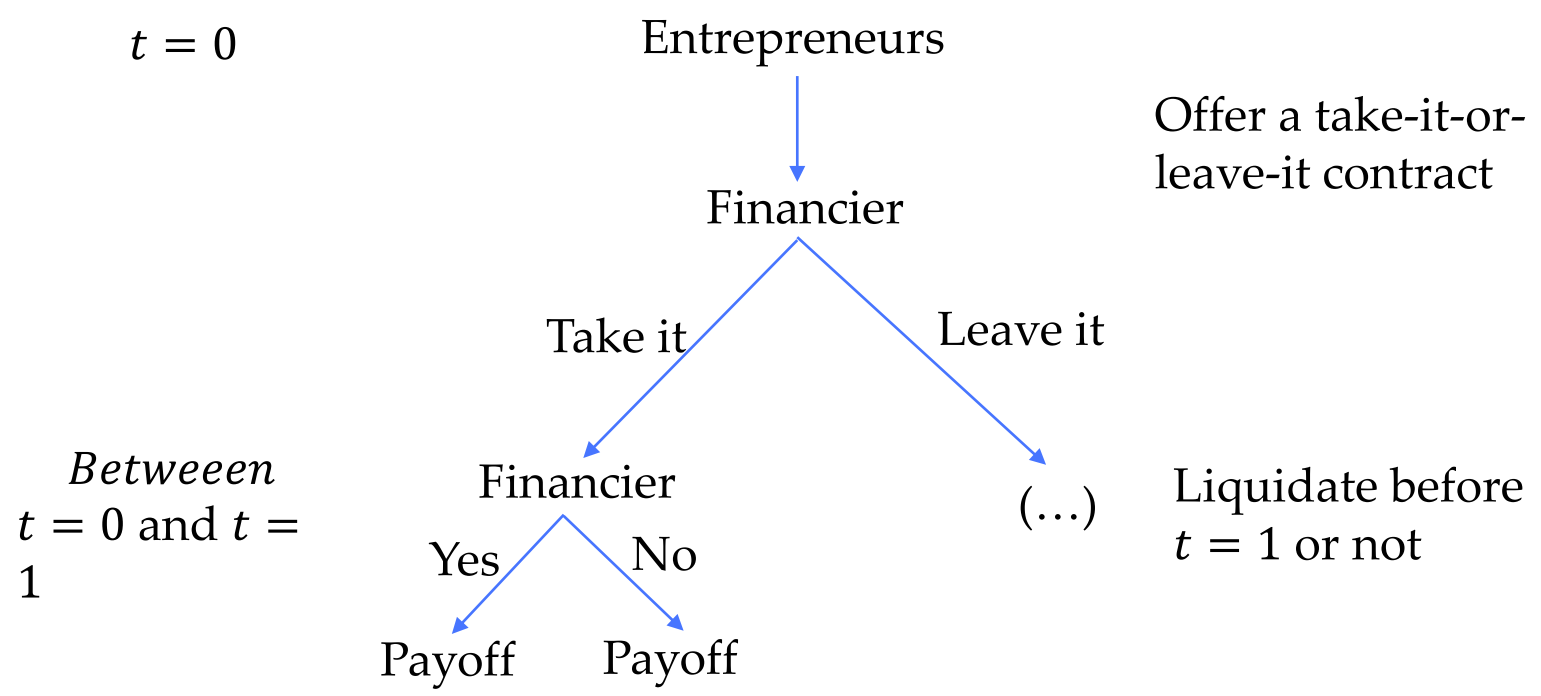
- Project:
  - Iy invested at $t = 0$
  - risk free y earned at $t = 0$
- Liquidation before $t = 1$: V_1 for the financier
- Liquidation before $t = 1$: αV_1 for other institutions
- Liquidation before $t = 1$: 0 for entrepreneurs

Simple Model: Renegotiation Proof (Cont.)

- Assume borrower has all the bargaining power
- At $t = 0$, a contract would be offered by entre
  - (M, R): money invested and repayment
- Entrepreneurs design the contract s.t.
  - $y - R \geq 0$
  - Financier has no incentive to liquidate before $t = 1$

Renegotiation Proof Contract

- Reduced to a two-stage dynamic game



Renegotiation Proof Contract (Cont.)

- Transformed into a Nash bargaining problem

$$\max\ [(R - M) - (V_1 - M)]^0 (y - R)^1$$
$$s.t.\ R - V_1 \geq 0$$
$$y - R \geq 0$$

- To induce financier into taking the offer
  - $R - M \geq 0$
- Outcome: (M, V_1) with $M \leq V_1$

Intermediary Financier No Cash

- Assume only the uniformed leader has funds
- Two ways now for entre to be invested
  - Directly from uniformed leader
  - Indirectly from intermediary

Intermediary Financier No Cash (Cont.)

- Case 1: directly from the uniformed leader
  - Liquidation value: αV_1
  - Outcome: $(M, \alpha V_1)$ with $M \leq \alpha V_1$
- Case 2: indirectly from intermediary
  - Intermediary: full bargaining power against leader
  - Contract between leader and intermediary: $(M_1, \alpha V_1)$, with $M_1 \leq \alpha V_1$
- Level of financing is limited

Bank Runs: Remedy to Limited Financing

- Consider instead there are two depositors
- A deposit contract is offered by intermediary
  - Amount raised: V_1
  - Withdrawal of $\frac{V_1}{2}$: allowed at any time
  - First come, first served

Non-renegotiability

- Without threat of renegotiation posed by bank

	Withdraw	Wait
Withdraw	$\left(\frac{\alpha V_1}{2}, \frac{\alpha V_1}{2}\right)$	$\left(\frac{d}{2}, \alpha V_1 - \frac{d}{2}\right)$
Wait	$\left(\alpha V_1 - \frac{d}{2}, \frac{d}{2}\right)$	$\left(\frac{V_1}{2}, \frac{V_1}{2}\right)$

Non-renegotiability: A Nash Implementation

- If threat of renegotiation posed by bank

	Withdraw	Wait
Withdraw	$\left(\frac{\alpha V_1}{2}, \frac{\alpha V_1}{2}\right)$	$\left(\frac{d}{2}, \alpha V_1 - \frac{d}{2} - \varepsilon\right)$
Wait	$\left(\alpha V_1 - \frac{d}{2} - \varepsilon, \frac{d}{2}\right)$	$\left(\frac{V_1}{2} - \varepsilon, \frac{V_1}{2} - \varepsilon\right)$

Non-renegotiability: Commitment

- Two depositors withdraw
- Banks go bankruptcy
- Two depositors inherit the loan
- Banks’ threat: incredible

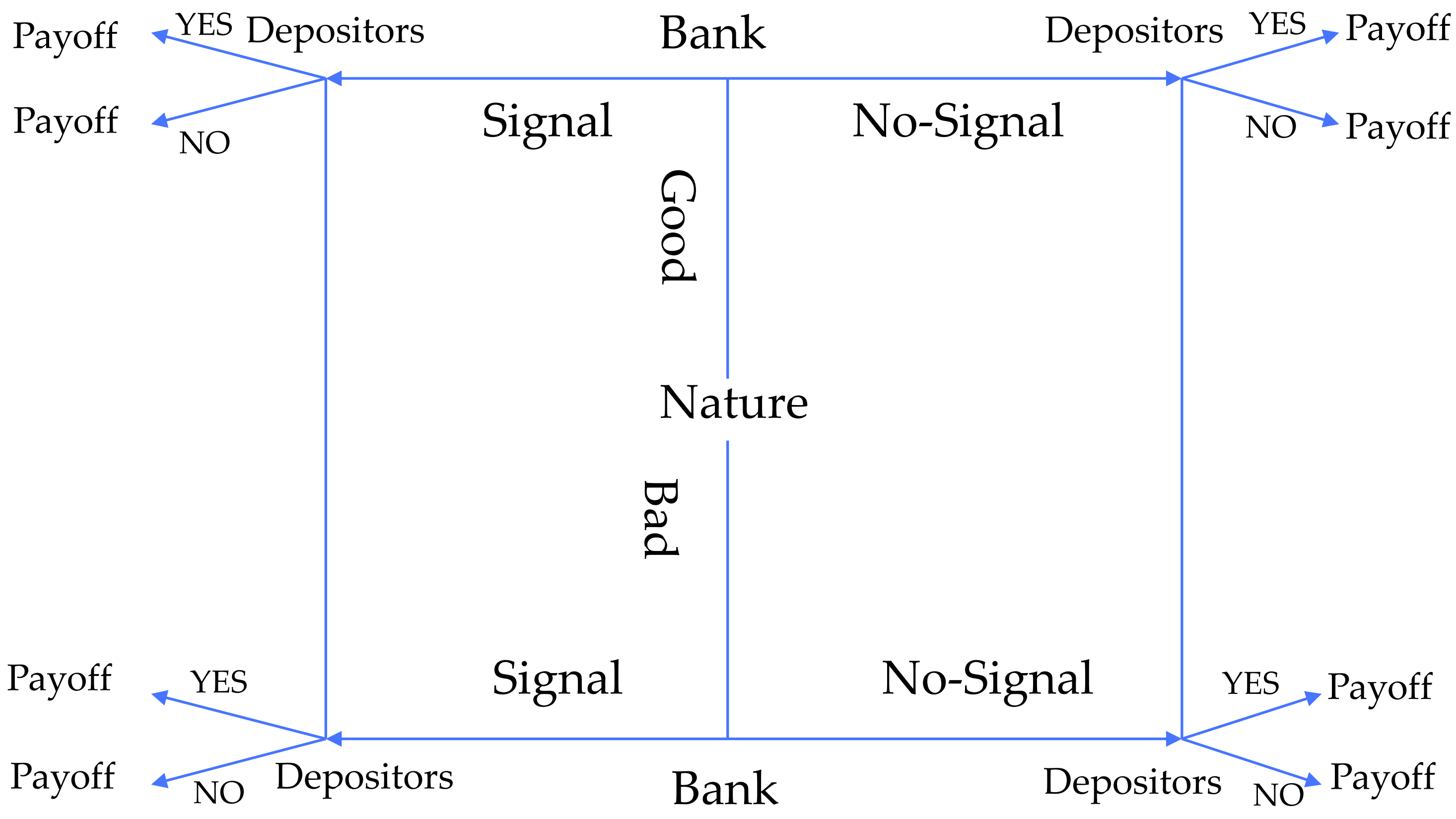
Non-renegotiability: Intuition

- Expectation of bank runs
  - Limit renegotiation ability of banks
  - Ensure a credible commitment by banks
  - Lead to a higher level of financing

Efficient Bank Runs

- Bank runs
  - Correct in part the incentives of management to forebear
- Bank runs are efficient whenever
  - $l > E(R|S)$
  - where S is a signal on the future return for long run technology

Reconstruction



Signaling form: advertising, financial disclosure, etc.

Extension: Interbank Markets

- Impossibility of liquidation: $l = 0$
- Banks with i.i.d. liquidity shocks
  - Proportion of patient depositors uncertainty
  - (π_L, π_H) with probability (p_L, p_H)
  - Completely diversified

Autarky

- An ex ante investment decision made
- Contingent contract

$$C_1(\pi) = \frac{1 - I}{\pi}, C_2(\pi) = \frac{RI}{1 - \pi}, \pi = \pi_L, \pi_H$$

- Depositors: bear the liquidity shock risk

Interbank Market: Optimal Allocation

$$\max \sum_{k=L,H} p_k\left[\pi_k u\left(C_1^k\right) + (1-\pi_k)u(C_2^k)\right]$$

$$s.t. \sum_{k=L,H} p_k \pi_k C_1^k = 1 - I$$

$$\sum_{k=L,H} p_k (1-\pi_k) C_2^k = RI$$

- $\left(C_1^k, C_2^k\right)$: deposit contract offered by a bank k

Interbank Market: Results

Results:

$$C_1^k \equiv C_1^* = \frac{1 - I^*}{\pi_a}, C_2^k \equiv C_2^* = \frac{RI^*}{1 - \pi_a}, k = L, H$$

where $\pi_a = p_L \pi_L + p_H \pi_H$

- Liquidity shock uncertainty eliminated

Optimal Allocation Decentralized

- Type L bank:
  - Extra liquidity: $M_L = 1 - I^* - \pi_L C_1^*$
- Type H bank:
  - Extra demand for liquidity: $M_H = \pi_H C_1^* - (1 - I^*)$
- Market clearing

$$p_L M_L = p_H M_H$$

Optimal Allocation Decentralized (Cont.)

- At $t = 2$, type H bank has extra liquidity

$$RI^* - (1 - \pi_H)C_2^*$$

- Repayment of interbank load

$$(1 + r)M_H$$

- Equalization yields

$$(1 + r) = \left(\frac{\pi_a}{1 - \pi_a}\right)\left(\frac{I^*}{1 - I^*}\right)R$$

Liquidity Depletion: Bank Runs

- Suppose now entrepreneurs faces uncertainty
  - Uncertainty in time point of returns: μ at $t = 1$
  - Liquidation at $t = 1$: αV_1
  - Liquidation at $t = 2$: αV_2

Liquidity Depletion: Loss for Bank Runs

- Entrepreneurs' loss: $y - R$
- Banks' loss: $R - \alpha\left(V_1 + \frac{V_2}{1+\rho}\right)$
  - ρ: equilibrium interest rate

Liquidity Depletion: Mechanism

- Case 1: no bank runs
  - Bank needs to acquire additional liquidity: $d - \mu R$
  - Only way: liquidate late project

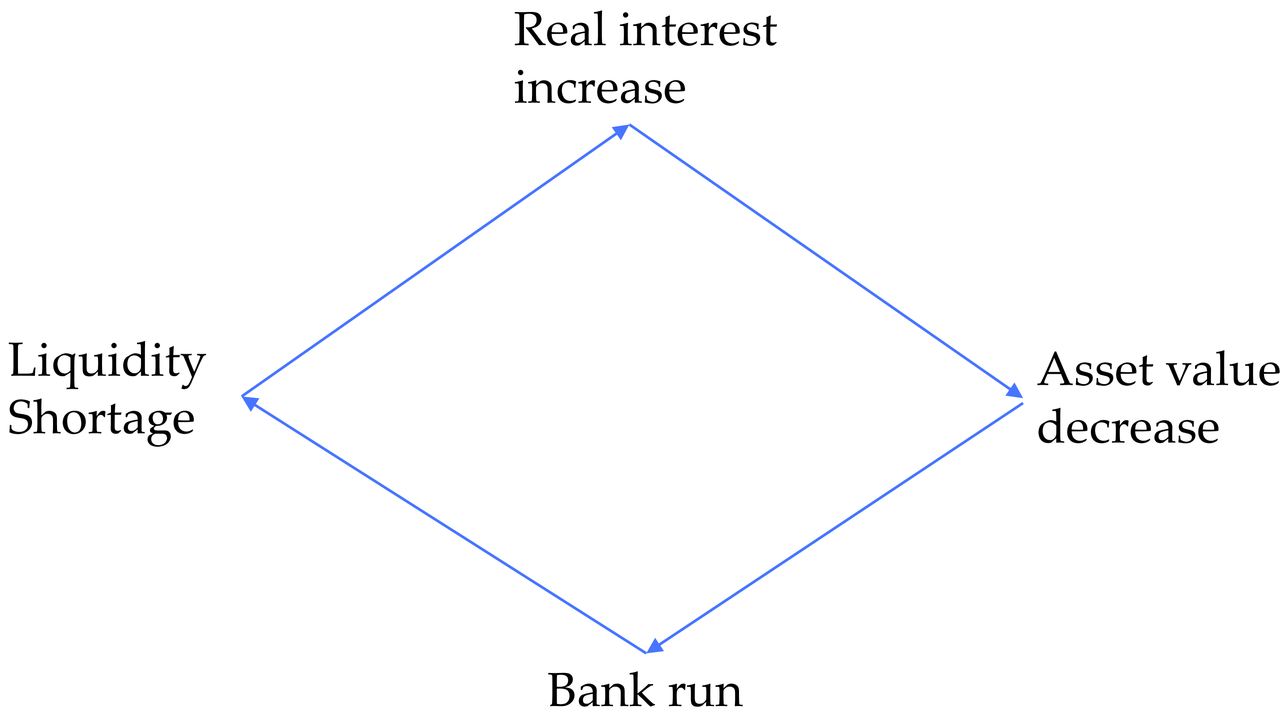
$$(1-\mu)\frac{\alpha V_2}{1+\rho}$$

  - where ρ is equilibrium discount rate
  - Entrepreneurs: $\mu(y - R)$ liquidity

Liquidity Depletion: Mechanism

- Case 2: a bank run
  - Banks' liquidity: $\mu\alpha V_1 < \mu R$
  - Entrepreneurs' liquidity: $\mu(y - R)$ destroyed
- Bank run depletes liquidity
  - Intuition: value-added technology suspended

Debt deflation



Contagious bank runs

Summary

- Background: Diamond and Dybvig (1983)
- Function of bank system
- Instability and remedies
- Back runs: sometimes efficient and useful