Bank Runs, Deposit Insurance, and Liquidity

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November 8, 2020

Overview

Key Concepts

- Bank Run:
  - A bank run occurs when a large number of customers of a bank or other financial institution withdraw their deposits simultaneously over concerns of the bank's solvency.
- Deposit Insurance:
  - A **statutory insurance** provided by FDIC in the US.
  - Fund by assessing a premium on banks, to protect against bank's default on deposit up to $250,000 per depositor, per insured bank.
- Liquidity:
  - In finance: ability to quickly purchase or sell an asset without causing a drastic change in the asset price.
  - In this paper: ability to have money to consume whenever you want.

Bank Run and Deposit Insurance in China

Sheyang Bank Run (Apr 2014)

Deposit Insurance Act **(May 2015)**

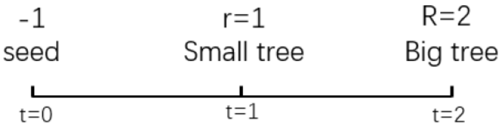
《存款保险条例》国务院令第660号

Abstract

- Why banks exist?
  - **Consumption time risk:** people have no plan when to consume.
  - **Demand deposit:** creation of liquid claims on illiquid asset.
- Model feature: multiple equilibrium of demand deposit:
  - **Good equilibrium vs Bank run equilibrium**
  - Bank run equilibrium cause real economic problems:
    - Illiquid Asset are liquidate early: return $\downarrow$
    - Even 'healthy' bank can fail.
- How to rule out the bank run equilibrium:
  - Suspension of convertibility
  - Deposit insurance

Model setup: Technology

- Technology:
  - $t = 0$: there is an investment opportunity cost \$1.
  - $t = 1$: you can liquidate the investment and get \$1 back.
  - $t = 2$: you can get full return $R > \$1$.



- Liquidating investment causes economic loss.

Model setup: Consumer

- Consumer:
  - Continuous with measure 1
  - People do not know when to consume at $t = 0$.

- $t = 1$: Uninsurable liquidity risk:
  - π proportion only care consumption at $t = 1$.
  - $1 - \pi$ proportion only care consumption at $t = 2$.

$$U(c_1, c_2; \Theta) = \begin{cases} u(c_1) & \text{if j is of type 1 in state } \Theta \\ \rho u(c_2) & \text{if j is of type 2 in state } \Theta \end{cases}$$

Model setup: Consumer

- Consumer objective function at $t = 0$:
  - vN-M utility form:

$$U(c_1, c_2) = \pi u(c_1) + (1 - \pi)\rho u(c_2)$$

  - $u(\cdot)$ satisfies Inada conditions.
  - Relative risk aversion coefficient $-cu''(c)/u'(c) > 1$

- Information:
  - First, we assume π is constant and public information.
  - However, Θ_j or whether a consumer is Type 1 or Type 2 is private information.

Scenario 1: Autarky

- Type 1 consumer will liquidate the consumption at $t = 1$ and type 2 consumer will keep the investment to $t = 2$.

$$U(c_1, c_2) = \pi u(1) + (1 - \pi)\rho u(R)$$

- Numerical example:
  - $u(c) = 1 - 1/c$
  - Percentage of Type 1 consumer $\pi = 0.25$
  - $R = 2$ and utility discount rate $\rho = 1$

$$U(c_1, c_2) = 0.25u(1) + 0.75u(2) = 0.375$$

- Not social optimal, because people are risk adverse, so they want to smooth consumption under two circumstances.

Scenario 2: Social planner

- Social planner problem:

$$\max_{(c_1,c_2)\in R_+^2} \pi u(c_1) + (1-\pi)\rho u(c_2)$$

$$s.t.\ \pi c_1 + (1-\pi)\frac{c_2}{R} = 1 \tag{1}$$

- FOC:

$$u'(c_1^*) = \rho R u'(c_2^*) \tag{2}$$

- We can prove that $1 < c_1^* < c_2^* < R$. (See footnote 3)
- Consider the numerical example before, the optimal consumption bundle is $(c_1^*, c_2^*) = (1.28, 1.813)$

Scenario 2: Social planner

- Consider numerical example before:
  - $u(c) = 1 - 1/c$
  - Percentage of Type 1 consumer $\pi = 0.25$
  - $R = 2$ and utility discount rate $\rho = 1$
- The optimal consumption bundle is $(c_1^*, c_2^*) = (1.28, 1.813)$
- $U^* = 0.25u(1.28) + 0.75u(1.813) = 0.391 > 0.375$

- So if there is a financial contract that cost 1 at $t = 0$ and pays $(1.28, 1.813)$ for type 1 and type 2 consumer at $t = 1$ and $t = 2$. Consumer will be willing to buy it.
  - Require private information Θ!
  - But we can let customer select themselves.
  - Check **self-selection constraints**.

Scenario 3: Bank

- Bank: Demand deposit, and investment.
- Bank promises r_1 interest rate if withdraw at $t = 1$, and rest of the money left for people withdraw at $t = 2$.
- **Sequential service constrain:**
  - f: the proportion of $t = 1$ withdraw
  - f_j: number of withdraw before j as fraction of total population

$$V_1(f_j; r_1) = \begin{cases} r_1 & \text{if } f_j < r_1^{-1} \\ 0 & \text{if } f_j \geq r_1^{-1} \end{cases}$$

$$V_2(f; r_1) = max\left[R\frac{1 - r_1 f}{1 - f}, 0\right]$$

- Where V_1 is the money received by people withdraw at $t = 1$ and V_2 is the money received by people withdraw at $t = 2$.

Scenario 3: Bank (Good Equilibrium)

Good Equilibrium

When $r_1 = c_1^*$ and only type 1 consumer withdraw at $t = 1$ ($f = \pi$):

- The demand deposit contract achieve social optimal.
- It is a Nash equilibrium.

- Consider numerical example before:
  - $u(c) = 1 - 1/c$
  - Percentage of Type 1 consumer $\pi = 0.25$
  - $R = 2$ and utility discount rate $\rho = 1$

- $(V_1, V_2) = (c_1^*, c_2^*) = (1.28, 1.813)$ achieves social optimal.
  - Type 1 will not betray: consumption at $t = 2$ is useless.
  - Type 2 will not betray: $V_2 > V_1$
  - $\Rightarrow$ **Nash equilibrium**

Scenario 3: Bank (Bank Run Equilibrium)

Bank Run Equilibrium

When $r_1 > 1$ and all consumers withdraw at $t = 1$ $(f = 1)$:

- It is a Nash equilibrium.

- At $t = 1$, random r_1^{-1} proportion get r_1, and the remaining get 0.
  - Type 1 will not betray: consumption at $t = 2$ is useless.
  - Type 2 will not betray: there is noting left if not withdraw.
  - $\Rightarrow$ **Nash equilibrium**

- **Social welfare:**

Good Equilibrium $>$ Autarky (No Bank) $>$ Bank Run Equilibrium

Scenario 4: Bank (Suspension of Convertibility)

- So how to protect against bank run (rule out the bad equilibrium)?
  - Suspension of convertibility
  - Government deposit insurance

- **Suspension of convertibility**
  - Bank stops return money at $t = 1$ after $\hat{f}$ of withdraw.

$$V_1(f_j; r_1) = \begin{cases} r_1 & \text{if } f_j \leq \hat{f} \\ 0 & \text{if } f_j > \hat{f} \end{cases}$$

$$V_2(f; r_1) = max\left[R\frac{1 - r_1 f}{1 - f},\ R\frac{1 - r_1 \hat{f}}{1 - \hat{f}}\right]$$

Scenario 4: Bank (Suspension of Convertibility)

Suspension of Convertibility When π is Constant

When $\hat{f} \in \{\pi, (R - r_1)/r_1(R-1)\}$:

- Good equilibrium is the only (dominate strategies) Nash equilibrium.
- It achieves social optimal.

- Check $\hat{f} = \pi$ as example:
  - Type 1 will not betray: consumption at $t = 2$ is useless
  - Type 2 will not betray: at $t = 2$ they can get at least as much as withdraw at $t = 1$.
- Suspension of convertibility during Greek Debt Crisis.

Scenario 4: Bank (Suspension of Convertibility)

Optimal Contract with Stochastic Withdraw

Any bank contracts which obey the sequential service constrain (including suspension of convertibility) **CANNOT** achieve social optimal with proportion of type 1 consumer π is stochastic and has a non-degenerate distribution.

- We can prove this by contradiction (P412-P413).
- Although it cannot be optimal, suspension of convertibility can also rule out bank run equilibrium when π is stochastic $\Rightarrow$ welfare gain.

Scenario 5: Bank (Deposit Insurance)

- Government can impose tax **after** withdraw realized.
- **Deposit insurance**
  - Funded by wealth tax on all wealth on $t = 1$.
  - $\Rightarrow$ Tax is determined after the government know how much withdraw f realized at $t = 1$.
  - $\Rightarrow$ Proportionate tax as a function of f:

$$\tau(f) = \begin{cases} 1 - \dfrac{c_1^*(f)}{r_1} & \text{if } f \leq \bar{\pi} \\ 1 - r_1^{-1} & \text{if } f > \bar{\pi} \end{cases}$$

  - Where $\bar{\pi}$ is the maximum possible realization of π.
  - Tax is plowed back into bank for consumer withdraw at $t = 2$.

Scenario 5: Bank (Deposit Insurance)

- After-tax proceeds, per dollar of deposit of withdrawal at $t = 1$, for $f_j \leq f$:

$$\hat{V}_1(f) = \begin{cases} c_1^*(f) & \text{if } f \leq \bar{\pi} \\ 1 & \text{if } f > \bar{\pi} \end{cases}$$

- After-tax proceeds, per dollar of deposit of withdrawal at $t = 2$:

$$\hat{V}_2(f) = \begin{cases} R\dfrac{1 - c_1^*(f)f}{1 - f} = c_2^*(f) & \text{if } f \leq \bar{\pi} \\ R\dfrac{1 - f}{1 - f} = R & \text{if } f > \bar{\pi} \end{cases}$$

- Notice that $\hat{V}_2(f) > \hat{V}_1(f)$ for all $f \in [0, 1]$:
  - It means type 2 will not withdraw at $t = 1$
  - **Exist a unique (dominate strategies) Nash equilibrium.**

Scenario 5: Bank (Deposit Insurance)

Demand Deposit Contracts with Deposit Insurance

Demand deposit contacts with government deposit insurance achieve the unconstrained **optimum** as a **unique** Nash equilibrium if the government imposes an optimal tax to finance the deposit insurance.

- At Nash equilibrium:
  - Only type 1 withdraw at $t = 1$, so $f = t$:

$$\hat{V}_1(f = t) = c_1^*(\pi)$$

$$\hat{V}_2(f = t) = R\frac{1 - \pi c_1^*}{1 - \pi} = c_2^*(\pi)$$

Discussion

- Them model provides insights in:
  - Risk sharing and liquidity provision function of banks
  - The strategic interaction between depositors
  - The cause, welfare loss of bank run, and how to protect against it
- This model assume single bank and riskless technology:
  - When there are multiple risky technology:
  - **Moral hazard:** Deposit insurance may encourage risk-taking investment.
- Government deposit insurance vs commercial deposit insurance
- Other application:
  - Discount window lending of central bank and inflation tax.
  - Bankruptcy protection $\Leftrightarrow$ Suspension of convertibility.

Extensions

- Secondary market (Dong, P54.)
  - Two types of technologies
  - Trade between two types of investors
- Debt vs. equity contract (Dong, P57.)
  - Financial intermediate is a mutual fund rather than a bank.
  - Mutual fund is free from bank run equilibrium.
- Inter-bank asset market and multiple equilibrium (Dong, P59.).

The End! Thanks for listening!