Bank Runs, Deposit Insurance, and Liquidity

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They provide a first rationale for:

1. Existence of Banks: Maturity transformation
2. Existence of Bank runs

Bank demand deposit contracts:

- *can* provide allocation superior to competitive markets
- are subject to bank runs

Partial Remedies:

- Suspension of Convertibility
- Deposit Insurance (Discount Window, Lender of Last Resort)

Bank runs *directly* causes real damage by interrupting production
The Model Environment

- **Endowm.**
  - $t = 0$: 1
  - $t = 1$: 0
  - $t = 2$: 0

- **Projects**
  - $t = 0$: 1
  - $t = 1$: 0
  - $t = 2$: 1

- **Liquidity shock** (private inform.)

- $U(c_1)$
- $U(c_2)$
The Model Environment

- Technology

\[
\begin{array}{ccc}
T = 0 & T = 1 & T = 2 \\
0 & R & \\
-1 & 1 & 0
\end{array}
\]

- Private Technology (not observable): \(-1 \rightarrow 1\)

- Preferences (private information)

\[
U(c_1, c_2; \theta) = \begin{cases} 
  u(c_1) & \text{if impatient} \\
  \rho u(c_1 + c_2) (1 - t) & \text{if patient}
\end{cases}
\]

\(t \in (0, 1)\), not stochastic (for the moment)

- Timing: investment decision before knowing their type
The Competitive Solution

- Imperfect Information $\equiv$ Autarky
  - Patient Type: $c_1^1 = 1$, $c_1^2 = 0$
  - Impatient Type: $c_1^2 = 0$, $c_2^2 = R$
  - Interpretation: $c_1^1 << c_2^2$, no risk sharing

- Perfect Information
  - $c_1^{1*} = c_2^{2*} = 0$
  - MRS = MRT: $u'(c_1^{1*}) = \rho R u'(c_2^{2*})$
  - Resource Constraint: $tc_1^{1*} + [(1 - t)c_2^{2*}/R] = 1$
  - Interpretation: $1 = c_1^1 < c_1^{1*} < c_2^{2*} < c_2^2 = R$: optimal risk sharing

... Room for improvement
The Competitive Solution

- Imperfect Information \(\equiv\) Autarky
  - Patient Type: \(c_1^1 = 1, c_1^2 = 0\)
  - Impatient Type: \(c_1^2 = 0, c_2^2 = R\)
  - Interpretation: \(c_1^1 << c_2^2\), no risk sharing

- Perfect Information
  - \(c_2^1 = c_2^2 = 0\)
  - MRS = MRT: \(u'(c_1^1) = \rho Ru'(c_2^2)\)
  - Resource Constraint: \(tc_1^1 + [(1 - t)c_2^2/R] = 1\)
  - Interpretation: \(1 = c_1^1 < c_1^1 < c_2^2 < c_2^2 = R\): optimal risk sharing

... Room for improvement
Demand deposit contract

- Bank mutually owned and liquidated in period 2

- The Demand Deposit Contract
  - $T = 1$: promises $r_1$ to agent withdrawing
  - $T = 2$: pro-rata share of what is left
  - Sequential service constraint

- $V_1(f_j, r_1)$: period 1 Payoff
  \[
  V_1(f_j, r_1) = \begin{cases} 
  r_1 & \text{if } f_j < r_1^{-1} \\
  0 & \text{if } f_j \geq r_1^{-1} 
  \end{cases}
  \]

- $V_2(f, r_1)$: period 2 Payoff
  \[
  V_2(f, r_1) = \max\{R(1 - r_1 f)/(1 - f), 0\}
  \]
Good equilibrium: Optimal Risk Sharing

\[(r_1, V_1(f_j, r_1), V_2(f, r_1)) = (c_1^{1*}, c_1^{1*}, c_2^{2*}) \text{ and } f = t\]

- BUT in \( T = 1 \) … Face value of deposits > liquidation value of bank assets

Bad equilibrium: Bank Runs

- if \( r_1 = 1 \): Bank runs are not an equilibrium: \( V_1(f_j, 1) < V_2(f, 1) \)
- If \( r_1 > 1 \): Bank runs are an equilibrium
- Allocations are worse for all agents: \( E[c] = 1 \)
- Production is interrupted at \( T = 1 \)

Selection of Eq: Commonly observed variable (need not to be fundamental)
The Demand Deposit Contract

- $T = 1$: promises $r_1$ to agent withdrawing
- $T = 2$: pro-rata share of what is left
- Sequential service constraint
- Suspension of convertibility after $t \leq \hat{f} < r^{-1} = (c_1^*)^{-1}$

$V_1(f_j, r_1)$: period 1 Payoff

$$V_1(f_j, r_1) = \begin{cases} r_1 & \text{if } f_j < \hat{f} \\ 0 & \text{if } f_j \geq \hat{f} \end{cases}$$

$V_2(f, r_1)$: period 2 Payoff

$$V_1(f_j, r_1) = \max \left\{ R(1 - r_1 f)/(1 - f), R(1 - r_1 \hat{f})/(1 - \hat{f}) \right\}$$
The Nash Equilibria - Part 2

Suspension of convertibility clause

- Good equilibrium: Optimal Risk Sharing

\[(r_1, V_1(f_j, r_1), V_2(f, r_1)) = (c_1^{1*}, c_1^{1*}, c_2^{2*}) \text{ and } f = t\]

for any \( \hat{f} \in \{t, (R - r_1)/[r_1(R - 1)]\} \rightarrow V_2(\cdot) > V_1(\cdot)\)

- Rules out bad equilibrium
- Proof

Result: If no Bank runs \(\rightarrow\) full-information optimum

- \(t\) deterministic \(\rightarrow\) No Bank runs
- \(t\)-stochastic \(\rightarrow\) We are in trouble
Introduction

The Nash Equilibria - Part 3

Suspension of convertibility clause $t$ - stochastic

Assumptions:

- $\tilde{t}$ is a R.V
- no agent is more informed than others about $\tilde{t}$

Equilibrium:

- Full information Equilibrium. Given $\tilde{t} = t$,
  
  $c_2^{1*} = c_1^{2*} = 0$, unique asset liquidation rule

- No Bank Contract with s.s.c. can achieve optimal risk sharing
Government Deposit Insurance

- Achieves Good equilibrium if taxation is optimal
- Levy taxes after withdrawal → potential benefit of Gvm. Int.
- Tax scheme: (Withdrawers in $T = 1, f, r_1$)

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

- $\hat{V}_1(f, r_1)$: period 1 After-Tax Payoff

$$
\hat{V}_1(f, r_1) = \begin{cases} 
c_1^*(f) & \text{if } f \leq \bar{t} \\
1 & \text{if } f > \bar{t}
\end{cases}
$$

- $\hat{V}_2(f, r_1)$: period 2 After-Tax Payoff

$$
\hat{V}_2(f, r_1) = \begin{cases} 
R(1 - c_1^*(f)f)/(1 - f) = R & \text{if } f \leq \bar{t} \\
\frac{R(1 - f)}{(1 - f)} & \text{if } f > \bar{t}
\end{cases}
$$
Government Deposit Insurance

- Shortcomings:
  - Unconstrained tax policy
  - $t$ deterministic $\rightarrow$ otherwise tax distortions
Conclusions and Implication

- Rationalize existence of banks
- Rationalize existence of bank runs
  - Bank Runs not related to riskiness of the technology
- Deposit insurance dominate equilibrium without $\rightarrow$ Role for Gvmt.
  - Riskless technology $\rightarrow$ Deposit insurance abstract from bank portfolio ch.
  - Risky technology $\rightarrow$ Moral hazard $\rightarrow$ Deposit insurance harshens
- FED discount window:
  - Riskless technology $\rightarrow$ tantamount Deposit insurance
  - Risky technology $\rightarrow$ Moral Hazard $\rightarrow$ ↑ Bank Risk vs bail-out policy
- Analysis extend to firms - short-term liability long-term assets
Proof 2

- Impatient Consumers always withdraw: $t \leq f$

- What about Patient Agents?
  - If they don’t: $c_2^* = \frac{R(1-tc_1^*)}{1-t}$ → Good Nash Eq.
  - If they do: Lottery in $T = 1$ vs $T = 2$

  Get in $T = 1 = \begin{cases} c_1^* & \hat{f} \\ 0 & 1 - \hat{f} \end{cases}$

  Get in $T = 2 = \frac{R(1-\hat{f}c_1^*)}{1-\hat{f}}$

  $\mathbb{E}[\text{Get in } T = 1] = \hat{f} c_1^*$
  - Decreasing in $f$

Conclusion: if $\hat{f} c_1^* \leq \frac{R(1-\hat{f}c_1^*)}{1-\hat{f}}$ No bank run!

Then: $\hat{f} \in \{t, (R - c_1^*)/ [c_1^*(R - 1)]\}$