# The Macroeconomics of Imperfect Capital Markets

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## Lecture 9: Liquidity and Runs

# Competing Definitions of Liquidity

**Alternative Definitions of Liquidity:**

- Liquidity as availability of a store of value
  - existence of liquid instruments
  - allows for implementation of contingent plans

  $\longrightarrow$ economy-specific
- Market liquidity: ability to exchange an asset into a more liquid asset
  - quickly / at any time
  - without affecting the market value
  - with low transaction costs

  $\longrightarrow$ asset-specific
- Funding liquidity: ability of agents to access new finance
  - quickly
  - at reasonable rates

  or: ability to meet financial obligations in a timely manner

  $\longrightarrow$ agent-specific

# Liquidity

**Different Categories of Liquidity:**

- are mutually reinforcing
- can be asset/agent-specific or driven by systemic factors

**Questions:**

- What is the most liquid asset?
- What is the most liquid market?
- What characterizes the most liquid firms?

- What are the similarities/differences between these forms of liquidity?

# Bank Runs, Deposit Insurance & Liquidity

**Diamond and Dybvig (1983): Bank Runs, Deposit Insurance, and Liquidity:**

- Bank deposits allow sharing of liquidity risk in the economy
  $\longrightarrow$ improve intertemporal allocations
- BUT: deposit contracts have multiple equilibria,
  one of which is a bank run
- Bank runs cause real (and unnecessary) economic damage
  because they suboptimally interrupt production

**Two solutions:**

- Suspension of convertibility
- Deposit insurance

# Concept of "Liquidity Risk"

**Liquidity Risk:**

- Long term investment yields higher returns than short-term investment, but entails large costs if liquidated prematurely
- Consumers subject to uninsurable (and unobservable) liquidity risk
- Banks can pool and diversify liquidity risk
  $\longrightarrow$ offer liabilities with smoother returns
- BUT: possibility of bank run equilibria:
  - all depositors simultaneously choose to redeem deposits early
  - risk pooling unravels
  - production interrupted and premature liquidations
- Potential causes for bank runs: shifts in expectations,
  e.g. commonly observed random variables such as bank earnings, runs on other banks, sunspots etc.

# Model

**Model setup:**

- Three time periods: 0, 1, 2
- Technology: 1 unit invested at $T = 0$ yields:
  - $R > 1$ units at $T = 2$ or
  - 1 unit if liquidated early at $T = 1$
  - alternative storage technology: yields 1 unit next period
- Consumers: face privately observed liquidity risk at $T = 1$:
  - fraction $t$ is of type 1: impatient: $U = u(c_1)$
  - fraction $1 - t$ is of type 2: patient: $U = \rho u(c_1 + c_2)$, $1 > \rho > \frac{1}{R}$

# Types of Equilibria

**Autarky Equilibrium:**

- Each consumer invests 1 unit
- Type 1 liquidates at $T = 1 \rightarrow c_1^1 = 1$
- Type 2 obtains $R$ at $T = 2 \rightarrow c_2^2 = R$

**Full Information Equilibrium:** optimal insurance against liquidity shock

- Agents would like to insure against preference shock
- Optimality condition: $u'\left(c_1^{1*}\right) = \rho R u'\left(c_2^{2*}\right)$
- Resource constraint: $tc_1^{1*} + (1-t)\frac{c_2^{2*}}{R} = 1$
- Outcome: $1 < c_1^{1*} < c_2^{2*} < R$

**BUT:** liquidity types are private information

# Role of Bank Deposits

**Bank deposits:** can fulfill this insurance function

- guarantee better return $r_1 > 1$ for type 1 agents
- BUT: risk of bank runs

Assume **sequential service constraint** at $T = 1$**:**

- payoff of depositors withdrawing funds depends on position in line
- denote $f_j$ position of depositor $j$ and $f$ as total withdrawals

$$V_1(f_j, r_1) = \begin{cases} r_1 \text{ if } f_j \leq \frac{1}{r} \\ 0 \text{ if } f_j > \frac{1}{r} \end{cases}$$

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

# Equilibria with Bank Deposits

1. Optimal risk sharing equilibrium: can replicate first-best
   - only type 1 consumers withdraw at $T = 1$; $c_1 = r_1 = c_1^{1*}$
   - type 2 consumers obtain high return at $T = 2$: $c_2 = \frac{R(1-c_1 t)}{1-t} = c_2^{2*}$

2. Bank run equilibrium: type 2 agents panick and withdraw early:
   - first $\frac{1}{r_1}$ agents obtain $r_1 \longrightarrow$ suboptimal liquidations
   - remainder receive nothing $\longrightarrow$ suboptimal risk-sharing

**Note:** if $r_1 = 1$:

- bank run equilibrium disappears
- but banks can no longer offer liquidity services

# Suspension of Convertibility

**One solution: suspension of convertibility** (of deposits into specie): bank announces suspension after fraction $\hat{f} < \frac{1}{r_1}$ has been withdrawn

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

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

for $r_1 = c_1^{1*}$ and $\hat{f} \in \left[t, \frac{R - r_1}{r_1(R-1)}\right]$: dominant strategy for type 2 is to wait

# Stochastic Withdrawals

**Suspension of convertibility under stochastic withdrawals:**

- assume stochastic mass of agents facing liquidity shock $t = \tilde{t}_1$:
- suspension of convertibility can no longer implement social optimum
- (banks learns realization $\tilde{t}_1$ as it serves withdrawals)
  $\longrightarrow$ if $V_1(f_1)$ is non-constant: optimal risk-sharing violated
  $\longrightarrow$ if $V_1(f_1)$ is constant: it cannot be contingent on $\tilde{t}_1$

**Still, if range of $\tilde{t}_1$ is not too wide:**

- suspension can improve ex-ante welfare
- but it hurts type 1 depositors who cannot withdraw

# Deposit Insurance

**Government deposit insurance** can restore first-best equilibrium:

- power of taxation alleviates reserve constraint of banks
- unconstrained optimum obtained as dominant strategy equilibrium
- implementation: denote highest possible $\tilde{t}_1$ as $\bar{t}$ and follow

$$V_1^*(f_j) = \begin{cases} c_1^{1*} \text{ if } f_j \leq \bar{t} \\ 1 \text{ if } f_j > \bar{t} \end{cases}$$

$$V_2^*(f) = \begin{cases} c_2^{2*} \text{ if } f \leq \bar{t} \\ R \text{ if } f > \bar{t} \end{cases}$$

  note: $V_1^*(f) < V_2^*(f) \; \forall \; f \in [0,1] \longrightarrow$ type 2 agents will never run
- credible institution means deposit insurance is never used!
  (and therefore no distortion from taxation)
- bank can follow optimal liquidation policy, independent of liquidity concerns

# Moral Hazard Problem

**Deposit insurance creates moral hazard:**

- risk-less technology abstracts from loan portfolio risk
- deposit insurance creates incentives to take on excessive risk
  $\longrightarrow$ deposit insurance should be accompanied by bank regulation

**Discretionary lender-of-last-resort:**

- run can occur in response to expectations about bailout probability

**Liquidity problems outside the financial sector:**

- bankruptcy protection acts like suspension of convertibility
- DIP-financing acts like deposit insurance

**Externality aspect:**

- early withdrawers impose negative externality on late withdrawers

# Critique by Calomiris-Kahn

**Critique by Calomiris and Kahn (1991):**

1. Banks are prohibited from suspending convertibility,
   even though it would be superior to liquidation
2. Fraud and conflict of interest prominent in most bank failures
   $\longrightarrow$ liquidation places assets out of reach of bankers
3. Withdrawals from informed depositors more prevalent
   than exogenous shocks to depositors' liquidity demand
4. Sequential service constraint is only optimal
   if benefit of early withdrawal is compensation for monitoring

# Chang and Velasco (2001)

**Open Economy Version of Diamond and Dybvig (1983)**

- banks in emerging economy provide liquidity insurance
- part of deposits from international lenders
- coordination problem extends to international lenders if
  - debt is short-term
  - international lenders do not roll over in crises

$\longrightarrow$ financial liberalization may increase financial fragility