Lecture 6: Liquidity Demand and Bank Runs

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Understanding sources of uncertainty

- Geanakoplos (and others): Emphasis on uncertainty during crises.

Next: Endogenous sources of uncertainty:

1. **Strategic uncertainty and bank runs.**
2. Counterparty risk/financial network (no time).
3. Knightian uncertainty/complexity (no time).

Liquidity demand and bank runs

Holmstrom-Tirole:

- Corporate liquidity demand and underinsurance wrt aggregate liquidity shocks.

Today: Diamond and Dybvig (1983) and subsequent literature.

- Financiers' liquidity demand with idiosycnratic shocks.
- Banks' role in liquidity provision.
- Coordination problems and runs/crises.
- Global games to link runs to fundamentals.
- Modern version of bank runs.

Roadmap

Diamond-Dybvig (1983): Consumers with liquidity shocks

- Three dates $t \in \{0, 1, 2\}$ and a single consumption good (dollar).
- Measure one of ex-ante identical consumers (Fs) with unit endowment at date 0. Consume either at date 1 or 2.
- **Liquidity shocks:** Preferences:

$$u(c_1, c_2) = \begin{cases} u(c_1) \text{ with prob. } \lambda, \text{ (if impatient)}, \\ u(c_1 + c_2) \text{ with prob. } 1 - \lambda, \text{ (if patient)}. \end{cases}$$

  Assume $u'(0) = \infty$.
- **Asymmetric information:** Types are consumers' private information.
- **Investment technology:** One dollar at date 0 yields $R > 1$ dollars at date 2 if project is completed, 1 dollar if terminated.

Consider autarky and optimal benchmarks

Autarky: Suppose each consumer acts in isolation. Consumer invests all endowment in the project and liquidates iff she is impatient. Yields:

$$c_1 = 1 \text{ and } c_2 = R. \tag{1}$$

Optimal allocation: Suppose a planner chooses (c_1, c_2) along with the aggregate liquidation decision, $y \in [0, 1]$. Solves:

$$\max_{c_1, c_2, y \in [0,1]} \lambda u(c_1) + (1 - \lambda) u(c_2) \tag{2}$$

$$(\text{RC}) \quad : \quad \left[\begin{array}{c} \lambda c_1 \leq y, \\ \text{and } (1 - \lambda) c_2 \leq y - \lambda c_1 + R(1 - y), \end{array} \right]$$

$$(\text{IC}): \quad c_1 \leq c_2.$$

- Why is the last condition necessary?

Characterization of the optimal allocation

Optimal allocation:

- First ignore the IC constraint (will verify that it will hold).
- We must have $y = \lambda c_1$ and $R(1-y) = (1-\lambda)c_2$.
- Using FOC, solution is given by $c_1 \in (0, 1/\lambda)$ that satisfies:

$$u'(c_1) = Ru'\left(\frac{R(1-\lambda c_1^*)}{1-\lambda}\right).$$

- This can concisely be written as

$$u'(c_1^*) = Ru'(c_2^*).$$

- It follows $c_1^* < c_2^*$, i.e., **(IC) constraint is automatically satisfied.**
- Optimal allocation equates MRS with the technological price.

Optimal allocation and liquidity insurance

- Define $\eta(c) \equiv -\frac{cu''(c)}{u'(c)}$ as the relative risk aversion coefficient.
- **Assumption:** $\eta(c) > 1$ for each $c > 0$.
- In this case, $c_1^* > 1$ and $c_2^* < R$. **Liquidity insurance**.
  (What happens if $\eta(c) = 1$ or $\eta(c) < 1$?)

Roadmap

1. Consumer liquidity demand and liquidity insurance
2. Implementation by bank deposits
3. Coordination based runs
4. Perspectives on modern runs

Implementation by bank deposits

Next: How to implement the optimal contract?

- Suppose there is a continuum of **competitive banks** that offer consumers a **demand deposit contract** at date 0.
- The contract, (c_1, c_2), is sold at 1 dollar at date 0 and promises c_1 if consumer withdraws at date 1, and c_2 if withdraws at date 2.
- Bank liquidates y at date 1 to meet early withdrawals and uses the rest of resources to pay for late withdrawals.
- Formally (following Tirole), let $\hat{\lambda} \geq \lambda$ denote the amount of consumers that withdraw. Then, a deposit contract pays:

$$\hat{c}_1 = \min\left\{c_1, \frac{1}{\hat{\lambda}}\right\}, \quad (3)$$

$$\hat{c}_2 = \max\left\{\left(\frac{1-\hat{\lambda}\hat{c}_1}{1-\hat{\lambda}}R, 0\right)\right\}.$$

Definition of equilibrium

- Let $(c_1, c_2) \equiv c \in \mathcal{C} \subset \mathbb{R}_{++} \times \mathbb{R}_{++}$ denote the set of feasible contracts [subject to (RC) and (IC)].

Postdeposit equilibrium: Given $c \in \mathcal{C}$, collection of withdrawal decisions and actual payoffs, $\left(\hat{\lambda}, \hat{c}_1, \hat{c}_2\right)$, such that agents optimize and payoffs are given by (3).

Predeposit equilibrium: Given a collection of postdeposit equilibria, $\left(\hat{\lambda}(c), \hat{c}_1(c), \hat{c}_2(c)\right)_{c \in \mathcal{C}}$, an equilibrium is $c^* = (c_1^*, c_2^*)$ that maximizes consumers' ex-ante utility:

$$\max_{c \in \mathcal{C} \cup \{0\}} \lambda u(\hat{c}_1(c)) + (1-\lambda) u(\hat{c}_2(c)), \tag{4}$$

where $c = 0$ captures autarky, i.e., $\hat{c}_1(0) = 1$ and $\hat{c}_2(0) = R$.

How to implement the optimal contract?

- For a feasible contract, the **no-run allocation** is always an equilibrium:

$$\left[\hat{\lambda}\left(c\right), \hat{c}_1\left(c\right), \hat{c}_2\left(c\right)\right] = \left[\lambda, c_1, c_2\right].$$

- With these postdeposit equilibria, banks' problem (4) is identical to the planner's problem (2).
- Predeposit equilibrium is then the same as the optimal allocation.

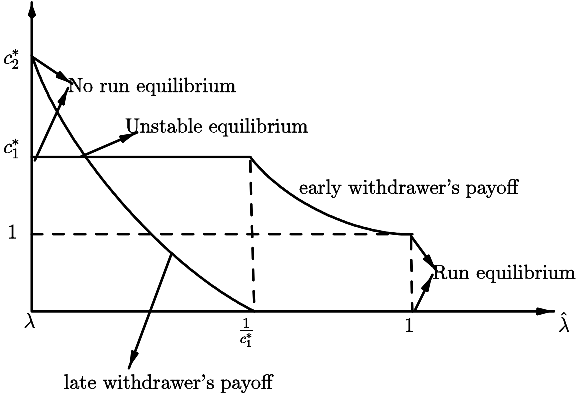
- Optimal allocation can be implemented with demand deposits.
- Banks might have a role in providing liquidity insurance.

Roadmap

An additional bank-run equilibrium

- The above describes an equilibrium, but can there be more?
- Consider the postdeposit game given contract (c_1^*, c_2^*).
- If all patients withdraw, early withdrawal yields $\hat{c}_1 = 1$ but late withdrawal yields $\hat{c}_2 = 0$.
- It becomes optimal to withdraw also for the patients!
- **Run equilibrium** (at date 1)**:** $\lambda = 1$, $\hat{c}_1 = 1$ and $\hat{c}_2 = 0$.
- **Intuition:** Strategic complementarities: Propensity to run, $\hat{c}_1 - \hat{c}_2$, is increasing in $\hat{\lambda}$ (over the relevant range).

Multiple equilibria from strategic complementarities



- Hence, the above implementation of optimal allocation is "fragile."
- **Asymmetric info plays a key role** for fragility/runs. Why?

Bank runs and strategic uncertainty

- **Coordination based runs. Not necessarily related to fundamentals.**
- We need to also solve for ex-ante contract anticipating a run.
- There are equilibria in which there is a run with positive probability.
- Unrelated random variable (**sunspot**) can serve as coordination device.

Strategic uncertainty: Generated by coordination failures/runs.

Potential solutions to the coordination problem

1. **Suspension of convertibility:** Cyprus recently, US 1814-1907.
   - Bank gives c_1^* to first λ people and 0 to the rest.
2. **Public deposit insurance:** FDIC insurance in the US since 1933.
   - Additional early withdrawals are paid from insurance.
   - No intervention in equilibrium. But eliminates bad equilibrium.
   - Introduces moral hazard (rich literature).
3. **Lender of last resort** has a similar effect.

Fundamental based runs: Global games

- Gorton (1988): Runs are related to the business cycle: "Every time a variable predicting a recession reached a threshold level, a panic occurred."
- Not consistent with DD's purely coordination based runs. Why?
- Can we reconcile fundamental based and panic based views?
- Yes, using global games techniques to select equilibrium in the latter:

$$\textbf{Negative shock to fundamentals} \implies$$
$$\textbf{Coordination on bad equilibrium} \implies \textbf{Runs}.$$

- See Morris-Shin (2000) for an illustration.

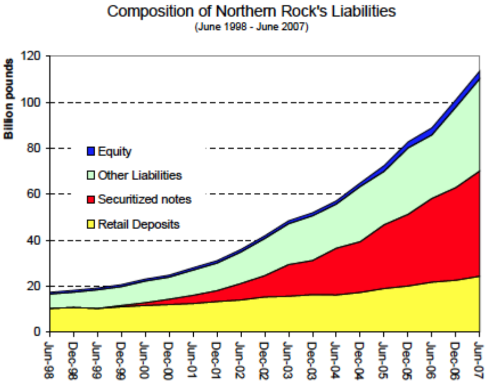
Roadmap

1. Consumer liquidity demand and liquidity insurance
2. Implementation by bank deposits
3. Coordination based runs
4. **Perspectives on modern runs**

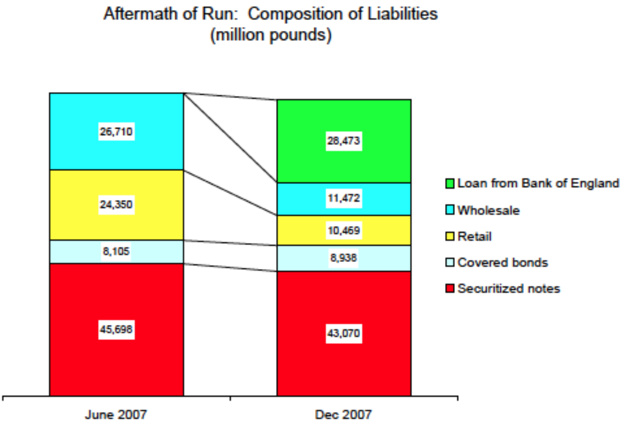
Shin (2009): A case study of Northern Rock

(AP)

- Depositors outside the UK Bank, Northern Rock, September 2007.
- First bank run in the UK since 1866.

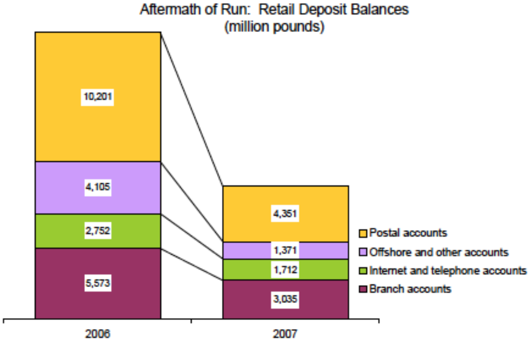


Retail deposits small fraction of Northern Rock's liabilities.



- Securitized deposits not the main problem since long term.
- Decline in retail deposits and wholesale funds.

A look at retail deposits



- But how about the timing of the reduction...

Retail deposits do not seem to be main problem

- Stressed start on August 9 when the short-term collateralized debt market almost froze.
- Depositor run much later (on September 14), and only after the public announcement of support by Bank of England.
- "The damage was already done well before the run by its retail depositors."
- "Irony of TV images of depositors queuing at the branch offices was that it was the branch deposits that were the most stable."
- "Although retail deposits can be withdrawn on demand, bankers have been heard to joke that a depositor is more likely to get divorced than to switch banks."

A look at wholesale funds

The 2006 annual report: "Following substantial inflows from **securitization** during the first half, we repaid net £2.3 billion, **mainly short term funds**. In the second half we raised a net £5.2 billion, leading to a full year net funding of £2.9 billion. During the year, we raised £3.2 billion **medium term** wholesale funds from a variety of globally spread sources, with specific emphasis on the **US, Europe, Asia and Australia**."

- Short term: Maturity less than 6 months. Medium: 6 months or longer.
- One source of short term funds is asset backed commercial paper...

A look at commercial paper market

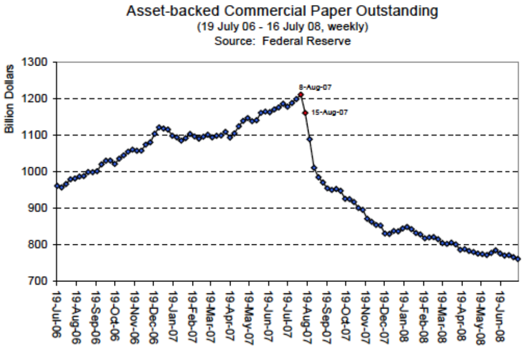


Figure 1

- Main problems appear to be in short-term debt markets.
- Northern Rock did not hold subprime mortgages, but it was "fishing from the same pool of short-term funding."

Bear Stearns episode also unrelated to deposits

> As you will see, the conclusion to which these data point is that the fate of Bear Stearns was the result of a lack of confidence, not a lack of capital. When the tumult began last week, and at all times until its agreement to be acquired by JP Morgan Chase during the weekend, the firm had a capital cushion well above what is required to meet supervisory standards calculated using the Basel II standard.
>
> Specifically, even at the time of its sale on Sunday, Bear Stearns' capital, and its broker-dealers' capital, exceeded supervisory standards. Counterparty withdrawals and credit denials, resulting in a loss of liquidity – not inadequate capital – caused Bear's demise.

- Chairman Cox on Bear Stearns: Emphasis on liquidity problems.
- Bear Stearns was not even a commercial bank. No retail deposits.

There is a modern version of traditional runs

- Traditional run mechanism can still apply after some relabeling:

$$\begin{aligned} \textbf{Short term debt} &\longrightarrow \text{Demand deposits,} \\ \text{Institutional investors} &\longrightarrow \text{Consumers.} \end{aligned}$$

- See He and Xiong (2010), “Dynamic Debt Runs.”

Caveat: Seems more relevant for **unsecured short term debt**:

- Mechanism relies on **cross pledging of collateral**.
- With collateralized loans, not much cross pledging.

Alternative view of modern runs: Credit crunch

Shin (2009) emphasizes: **Intermediation and credit crunch** as opposed to coordination problems.

- Northern Rock's creditors in wholesale funds are themselves banks.
- Tightening of their constraints reduces Northern Rock's pledgeability and liquidity (Holmstrom-Tirole, QJE), generating inefficient liquidations (Holmstrom-Tirole, JPE).
- Creditors' constraints in turn exacerbated by several mechanisms (e.g., Kiyotaki and Moore, 1997, Geanakoplos, 2011 etc.)

Open question: Empirical relevance of different mechanisms. Coordination problems or credit crunch?

Taking stock: Liquidity insurance and runs

- D-D: Consumers' demand for liquidity insurance.
- Insurance can be provided via bank deposits.
- Can generate coordination failures/runs and strategic uncertainty.
- Modern version with short term debt instead of deposits.
- Credit crunch provides an alternative modern run mechanism.