Interbank market liquidity and central bank intervention

by Allen, Carletti, and Gale - JME 2009

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The Model

- 3 periods $t = 0, 1, 2$
- 1 good
- Banks (large number): perfectly competitive + free entry
  $\Longrightarrow$ Maximize consumer's expected utility, zero profits
- Depositors:
  - Preferences

$$u_i(c_1, c_2) = \begin{cases} u(c_1) & \text{with prob } \lambda \\ u(c_2) & \text{with prob } 1-\lambda \end{cases}$$

  - Endowment: 1 unit of the good at $t = 1$

The Model

- The demand for liquidity in a given bank is a random variable

$$\lambda_{\theta i} = \underbrace{\alpha_i}_{\text{idiosyncratic}} + \varepsilon \underbrace{\theta}_{\text{aggregate}}$$

- Idiosyncratic shock

$$\alpha_i = \begin{cases} \alpha_H = \overline{\alpha} + \eta & \text{w.p. } \frac{1}{2} \\ \alpha_L = \overline{\alpha} - \eta & \text{w.p. } \frac{1}{2} \end{cases}$$

  where $1 > \alpha_H > \alpha_L > 0$.

- Aggregate shock

$$\theta = \begin{cases} 0 & \text{w.p. } \pi \\ 1 \text{ w.p. } & (1-\pi) \end{cases}$$

Assets

2 safe assets:

- Short asset: 1 unit at t, 1 unit at $t+1$.
- Long asset: 1 unit at $t=0$, $R>1$ units at $t=2$
  - At $t=1$ there is an interbank market for trading the long asset at price P_θ.

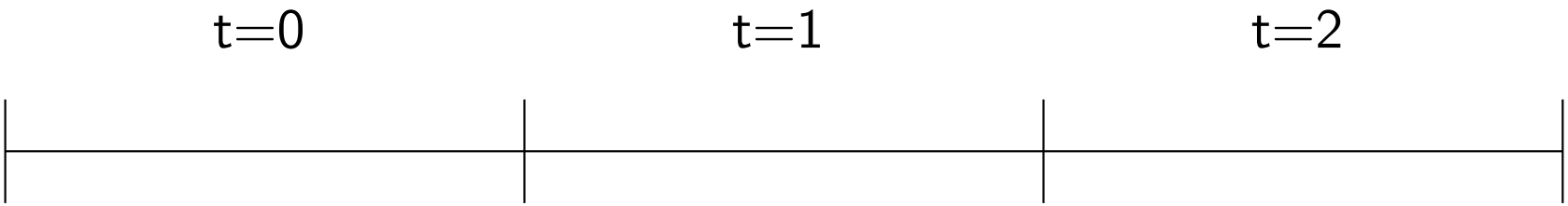
Deposit Contract

At $t = 0$, consumers and banks enter a deposit contract.

Definition

A deposit contract allows the consumer to withdraw either d units at date 1 or the residue of the bank's assets at date 2 divided equally among the remaining depositors.

Timing



- Deposits
- Contract: d
- Portfolio: y, 1-y

- θ is realized
- α_i is realized
- Interbank market
- Early withdrawals

Late withdrawals,

Figure: Timing

Constrained Efficient Allocation

Let $\lambda_0 = \overline{\alpha}$ and $\lambda_1 = \overline{\alpha} + \varepsilon$

$$\max_{d,y} E\left[\lambda_\theta u\left(d\right) + \left(1 - \lambda_\theta\right) u\left(c_{2\theta i}\right)\right]$$

s.t.

$$\begin{aligned} \lambda_\theta d &\leq y \\ \left(1 - \lambda_\theta\right) c_{2\theta} &= y - \lambda_\theta d + \left(1 - y\right) R \\ d &\leq c_{2\theta} \quad \theta = 0, 1 \ \ (IC) \end{aligned}$$

Assumptions:

- IC never binds
- Bank runs don't occur if contract is IC.

$$\Longrightarrow \lambda_1 d^* = y^*$$

Bank's Problem

$$\max_{d,y} E\left[\lambda_{\theta i} u\left(d\right) + \left(1 - \lambda_{\theta i}\right) u\left(c_{2\theta i}\right)\right]$$

s.t.

$$\begin{aligned} d &\geq 0,\ 0 \leq y \leq 1 \\ c_{2\theta i} &= \frac{R\left[1 - y + \frac{y - \lambda_{\theta i} d}{P_\theta}\right]}{1 - \lambda_{\theta i}},\ \theta = 0, 1,\ i = L, H \end{aligned}$$

Assumption:

- Bankruptcy is never optimal

$$\Longrightarrow y \geq \lambda_1 d$$

Interbank Market

In equilibrium:

$$P_0 = R \text{ and } P_1 < 1$$

Why?

- If $\theta = 0$, $y > \lambda_0 d \Longrightarrow$ excess liquidity, banks hold both assets $\Longrightarrow P_0 = R$
- If $\theta = 1$, $y \geq \lambda_1 d$. If $y > \lambda_1 d$, we would have $P_1 = R$, but this would imply $y = 0$
  $\Longrightarrow y = \lambda_1 d$ and $P_1 < 1$ (long asset doesn't dominate short asset)

No trading

If aggregate uncertainty is large enough relative to idiosyncratic uncertainty, $\varepsilon > \eta$, banks will stop trading with each other if $\theta = 0$, i.e,

$$\lambda_1 d > \lambda_{0H} d$$

Banks hit by a high liquidity shock in state $\theta = 0$, have enough liquidity to face their liquidity demand.

Central Bank intervention

- Can the central bank attain the constrained efficient allocation by intervening? Yes!
- If for a given intervention scheme, the individual allocation that attains the constrained efficient allocation is feasible for the individ
- Strategy: propose an intervention scheme that attains constrained efficiency and show that it is feasible for the bank.ual bank, it is also individually optimal.

Only Idiosyncratic Risk

$\eta > 0$, $\varepsilon = 0$
Intervention:

- $t = 0$, X_0 lump sum taxes on deposits to buy short term asset.
- $t = 1$, Open market operation, set $P = 1$ and sell all short term asset for X_0 units of long term asset.
- $t = 2$,Transfers to late consumers.

If $X_0 < 0$, the bank has a liability not an asset.
Bank's choice: $(y^* - X_0, d^*)$

Only Aggregate Risk

$\eta = 0$, $\varepsilon > 0$
Intervention:

- $t = 1$, Open market operation, set $P_0 = P_1 = 1$
  - If $\theta = 0$ issue $X_1 = \varepsilon d^*$ of debt that pays R at date 2 in exchange for short term asset. (drains liquidity)
  - If $\theta = 1$, no need to actively intervene in open market operations.
- $t = 2$, If $\theta = 0$,lump sum tax late consumers to repay debt.

Bank's choice: (y^*, d^*)

Idiosyncratic and Aggregate Risk

$\eta > 0$, $\varepsilon > 0$
Intervention:

- $t = 0$, X_0 lump sum taxes on deposits to buy short term asset.
- $t = 1$, Open market operation, set $P_0 = P_1 = 1$
  - If $\theta = 0$ issue X_1 of debt that pays R at date 2 in exchange for short term asset. (drains liquidity)

$$X_0 + X_1 = \varepsilon d^*$$

  - If $\theta = 1$, supply liquidity, sell all short term asset for X_0 units of long term asset.
- $t = 2$, lump sum tax to repay debt or transfer if there is enough left.

Bank's choice: $(y^* - X_0, d^*)$

No trading

If $\varepsilon > \eta$, banks will stop trading with each other if $\theta = 0$, i.e,

$$y^* = \lambda_1 d > \lambda_{0H} d$$

but H banks will still trade with the central bank.
Banks not lending to each other is not a sign of market failure!