14.02

Bank Runs

Fall 2009

1 Bank runs

- Diamond and Dybvig (1983)

- Three periods $T = 0, 1, 2$

- Continuum of agents

- Preferences

$$u\left(c_1 + \eta c_2\right)$$

where η idiosyncratic shock

$$\eta = \begin{cases} 0 & \text{with probability } \tau \quad (\text{"early consumer"}) \\ 1 & \text{with probability } 1-\tau \quad (\text{"late consumer"}) \end{cases}$$

- Agents have an endowment normalized to 1

- At time 0, each agent invests without knowing his shock η

- No aggregate uncertainty: exactly τ fraction of agents will have $\eta = 0$

- Technology: if an agent invests 1 at time 0, he can get:

  1. x if he chooses to liquidate a fraction x at time 1

  2. $R(1-x) \geq (1-x)$ if he liquidates $1-x$ at time 2

Autarky:

- single agent will choose how much to consume in two periods

$$\max_{x,c_1,c_2} \quad E\left[u\left(c_1(\eta)+\eta c_2(\eta)\right)\right]$$
$$c_1(\eta) \leq x$$
$$c_2(\eta) \leq R(1-x)$$

- optimal to choose

$$\begin{aligned} c_1(1) &= 0, c_2(1) = R \\ c_1(0) &= 1, c_2(0) = 0 \end{aligned}$$

Banks:

- risk sharing arrangement

$$\begin{aligned} \max \quad & E\left[u\left(c_1(\eta)+\eta c_2(\eta)\right)\right] \\ & E\left[c_1(\eta)\right] \leq x \\ & E\left[c_2(\eta)\right] \leq R(1-x) \end{aligned}$$

- optimal

$$c_1(1)=0, c_2(0)=0$$

and

$$u'\left(c_1(0)\right)=Ru'\left(c_2(1)\right)$$

Assumptions

- Assumption 1: high coefficient of relative risk aversion

- Assumption 2: avoiding liquidation is more profitable

$$R > \mathbf{1}$$

Optimal liquidation policy

- use C_1 for $c_1(0)$ and C_2 for $c_2(1)$
- resource constraint at time 2 imposes

$$(1 - \tau C_1) R = (1 - \tau) C_2$$

- find C_1 s.t.

$$u'(C_1) = Ru'\left(R\frac{1 - \tau C_1}{1 - \tau}\right)$$

- Result: under A1 and A2

$$1 < C_1 < C_2 < R$$

- *Some, but not complete, insurance for the early consumers*

- $\rightarrow$ autarky is suboptimal

- check that A2 is needed: with $u(c) = \log c$, then $C_1 = 1$ and $C_2 = R$ works

$$\begin{aligned} C_1^{-1} &= R\left(R\frac{1-\tau C_1}{1-\tau}\right)^{-1} \\ 1 &= R\left(R\frac{1-\tau}{1-\tau}\right)^{-1} \end{aligned}$$

- but not with CRA>1, e.g. $u(c) = c^{1-\gamma}/(1-\gamma)$, then

$$1^{-\gamma} > R\left(R\frac{1-\tau}{1-\tau}\right)^{-\gamma} \text{ if } \gamma > 1$$

How do we implement a banking allocation?

- Offer all consumers the option to withdraw C_1 in the first period: *demand deposit* contract

- incentive compatibility:

  1. for the early consumers is trivial:

$$u(C_1) \geq u(0 + 0C_2) = 0$$

  2. for the late consumers:

$$u(C_1) \geq u(C_2)$$

  because $C_2 > C_1$ (from result above)

Unique implementation?

- Given that the bank offers to all consumers the possibility to withdraw there exists an equilibrium where only early consumers withdraw (IC ensures that)

- but is that the only equilibrium?

- with a demand deposit contract NO

Bad equilibrium

- *All* consumers apply for C_1 in first period
- The bank only has 1 unit of asset to liquidate
- Some consumers are rationed (the ones last in line)

- Why late consumers do not wait?

- If you do not apply for C_1 you get

$$\tilde{C}_2 = R \frac{\max\{1 - \tilde{\tau} C_1, 0\}}{1 - \tilde{\tau}}$$

  where $\tilde{\tau}$ is the number of consumers who apply for C_1

- So if $\tilde{\tau} = 1$ then $\tilde{C}_2 = 0$

- If you expect everyone to run, running is a best response

Suspension of convertibility

- The bank announces: I'll give C_1 to the first τ people that show up in period 1, 0 to the rest of them

- Now it is optimal to wait for a late consumer

- Equilibrium is unique

- But now introduce some aggregate uncertainty about τ: τ is a random variable with CDF $F(\tau)$

- sometimes there is more early consumers, sometimes less

- Now optimum has

$$u'(C_1(\tau)) = Ru'\left(R\frac{1-\tau C_1(\tau)}{1-\tau}\right)$$

- This optimum is incentive compatible but it cannot be implemented if the bank is facing a *sequential service constraint*: You can only assign consumption to consumers who show up in period 1 on the basis of their position in the line

Simple alternative: Demand deposits + deposit insurance

- Historically this combination has proved very succesful

- Now is the government that takes care of making C_1 state contingent: if too many people show up, everyone is taxed so that they get paid and the late consumers are protected

- The government effectively has a way of intervening after τ is realized

- In this way the bad equilibrium is ruled out

- Important principle: the gov't does not actually intervene in equilibrium
- Just announcing intervention off-the-equilibrium path, eliminates the bad equilibrium
- These are very desirable policy interventions: no actual intervention (no tax levied, no distortion created), very big effects (sometimes too good to be true?)

Repo market: reinterpreting a bank run

- The bank borrows short term from the consumers to invest in long run project and at the same time sells equity shares

- Promises to repay rate of return $C_1/1 > 1$ with expectation that the loan will be rolled over

- If consumers decide to roll over they will get $C_2/1 > C_1/1$

- If loan not rolled over the bank won't be able to offer positive return to consumers $C_2/1$

- Bad equilibrium: banks refuse to roll over $\longrightarrow$ “run” followed by bankruptcy

- The model can be reinvented to better match the competitive determination of interest rates in repo markets (and the role of collateral)

- But the underlying logic is there

- See letter of Cox (SEC Chairman) to the Basel Committee

  http://www.sec.gov/news/press/2008/2008-48_letter.pdf

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