BANKING AND FINANCIAL FRAGILITY

Policy Responses to Financial Fragility

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Policy responses

- We have seen have banking arrangement are useful …
  - allow the economy to reach efficient allocations if all goes well
- But are also fragile
  - can "collapse" and lead to very bad outcomes
- What can governments and central banks do about this?
  - suppose we live in a Diamond-Dybvig world
  - what types of policies could prevent/mitigate bank runs?
  - what determines how effective these policies will be?

[see case study on money market mutual funds]

- We will examine three common policy proposals/actions

Outline

1. Deposit freezes
   - also called “suspending convertibility” or “erecting gates”
   - study the cases with and without commitment
2. Deposit insurance & government guarantees
   - with and without commitment
3. Narrow banking
   a) prohibiting maturity transformation
   b) replacing banks with mutual funds
      (or, maturity transformation through markets)

Policy Response 1: Deposit Freezes

Motivation

- Common response to a bank run: close the affected banks
  - "freeze" the remaining deposits in place for some time
- Many examples:
  - U.S. in 1933 (and earlier)
  - Argentina in 2001-2 ("el corralito")
  - Cyprus in 2013, Greece in 2015
- Ability to "erect gates" is seen a way to stabilize money market mutual funds in the future
- Readings:
  - Diamond and Dybvig (1983, Section 3)
  - Ennis and Keister (2009)

- Want to study deposit freezes in the context of our model
  - return to the baseline model of Diamond & Dybvig
- The analysis will depend critically on <u>when</u> the freeze policy is determined
- Study two cases:
  - with commitment (policy chosen at $t = 0$)
  - without commitment (policy chosen at $t = 1$)

1a. Deposit Freezes with Commitment (Diamond and Dybvig, 1983)

- Recall that the bank is a set of rules
  - a “machine” programmed at $t = 0$
- Suppose we change the rules to limit withdrawals at $t = 1$
  - maximum of $\lambda + \overline{e}$ where $\overline{e} \in [0,1 - \lambda]$
- If more investors attempt to withdraw at $t = 1$:
  - bank serves the first $\lambda + \overline{e}$, then closes
  - reopens at $t = 2$ and divides assets among remaining investors
- Goal of policy:
  - limit liquidation of investment at $t = 1$
  - so that patient investors have an incentive to wait until $t = 2$

- Everything else is unchanged from our baseline model
  - bank still invests x^* and place $1 - x^*$ in storage
  - gives c_1^* to investors who withdraw at $t = 1$
  - but now shuts down after $\lambda + \overline{e}$ withdrawals
- The parameter $\bar{e}$ is a policy choice
  - for now, chosen by investors when they set up the bank
- For any value of $\bar{e}$, there is still an equilibrium with $y_i = 2$ for all i
  - if no other patient investors will withdraw early …
  - … an individual is choosing between c_1^* and c_2^*

$\Rightarrow$ best response is to set $y_i = 2$

Q: Is there also a bank run equilibrium?

- Suppose $y_{-i} = 1$
  - expect all other investors to attempt to withdraw at $t = 1$
  - what is the best response of an individual patient investor?
- If she chooses $t = 1$, she either receives c_1^* …
  - … or is told to come back tomorrow if the bank has closed
- If she chooses $t = 2$, she receives:
  - an even share of the bank's remaining (matured) assets
  - critical question: what is this even share worth?

Q: What is an even share of the bank's assets at $t = 2$ worth?

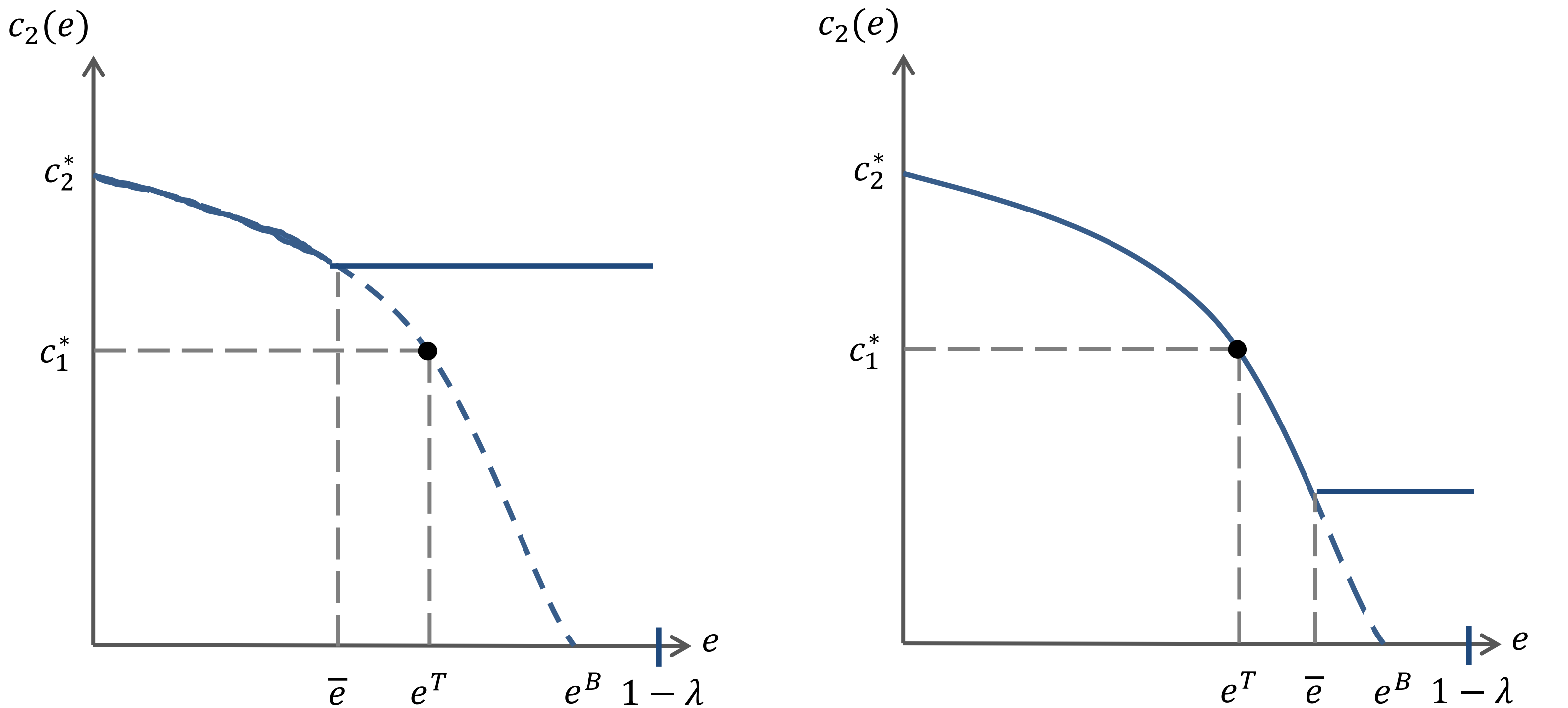
- Similar to the baseline model, but with a key difference

$$c_2(e) = \max \begin{cases} \dfrac{R\left(x^* - e\dfrac{c_1^*}{r}\right)}{1-\lambda-e}, 0 \\ \dfrac{R\left(x^* - \bar{e}\dfrac{c_1^*}{r}\right)}{1-\lambda-\bar{e}}, 0 \end{cases} \quad \text{if } e \begin{Bmatrix} \leq \\ > \end{Bmatrix} \bar{e}$$

where:

e = measure of patient investors who <u>attempt</u> to withdraw early

Two possibilities



- Investor's best response to $y_{-i} = 1$ is

$$y_i = \begin{Bmatrix} 2 \\ 1 \end{Bmatrix} \text{if } \bar{e} \begin{Bmatrix} \leq \\ \geq \end{Bmatrix} e^T$$

Result 1: For any $\bar{e} < e^T$, the withdrawal game has a unique Nash equilibrium: $y_i = 2$ for all i

- no bank run occurs in this equilibrium

⇒ deposits are never frozen (**!**)

  - policy has no cost in equilibrium

- For any $\bar{e} \geq e^T$, the bank run equilibrium ($y_i = 1$) also exists
  - a "late" deposit freeze policy does not prevent bank runs

- Diamond & Dybvig (1983) made λ a random variable
  - then a freeze occurs if the realization of λ is unusually large

[see case study on deposit freezes]

1b. Deposit Freezes without Commitment (Ennis and Keister, 2009)

- So far: $\bar{e}$ was part of the bank's fixed rules
  - bank operates as a machine
- Now: introduce a government that chooses $\bar{e}$
  - government is a player in our game
  - strategy: $\overline{e} \in [0,1-\lambda]$
  - objective: maximize the sum of investors' utilities
- We are expanding the withdrawal game
  - complete profile of strategies is now:

$$(y, \overline{e}) \in \{1,2\}_{i\in[0,1]} \times [0,1-\lambda]$$

  - government chooses best response to strategies of investors
  - investors choose best response to other investors and the govt.

Some intuition

- Note: government has the same objective as investors
  - one might therefore think that nothing changes …
- But it chooses $\bar{e}$ at $t = 1$ rather than at $t = 0$
  - this change in the timing of the decision is critical
- If a runs starts, freezing deposits is very costly
  - some impatient investors receive nothing at $t = 1$

  $\Rightarrow$ strong incentive for government to allow more withdrawals
- If investors expect the govt. to allow more withdrawals …
  - they realize some of the bank's investment will be liquidated
  - … which lowers the payments the bank can make at $t = 2$
  - … and may give them an incentive to join the run

The expanded withdrawal game

Q: Is there an equilibrium with $y_i = 1$ for all i?

- Suppose investors follow this strategy profile
  - what is the government's best response?
  - will choose $\bar{e}$ to maximize

$$W(\bar{e}) \equiv \underbrace{(\lambda + \bar{e})}_{\text{served at } t=1} u(c_1^*) + \underbrace{\lambda}_{\text{impatient}} \underbrace{(1 - \lambda - \bar{e})}_{\text{served at } t=2} u(0) + \underbrace{(1 - \lambda)}_{\text{patient}} \underbrace{(1 - \lambda - \bar{e})}_{\text{served at } t=2} u(c_2(\bar{e}))$$

subject to

$$c_2(\bar{e}) = \max\left\{ \frac{R\left(x^* - \bar{e}\frac{c_1^*}{r}\right)}{1 - \lambda - \bar{e}}, 0 \right\}$$

$$0 \le \bar{e} \le e^B$$

Solution: $\bar{e}^*$

- Next, supposing $y_{-i} = 1$ and given $\bar{e}^*$…
  - what should investor i do if patient?

- … the best response of investor i is:

$$\text{if } \bar{e}^* \begin{Bmatrix} \leq \\ \geq \end{Bmatrix} e^T, \text{then } y_i = \begin{Bmatrix} 2 \\ 1 \end{Bmatrix}$$

<u>Result 2</u>: A bank run equilibrium exists if and only if

$$\bar{e}^* \geq e^T.$$

- (Can verify:) In some cases, $\bar{e}^* = 0$
- But in other cases, $\bar{e}^* > e^T$

What determines $\bar{e}^*$?

- Repeating the objective function

$$W(\overline{e}) \equiv (\lambda + \overline{e})u(c_1^*) + \lambda(1-\lambda-\overline{e})u(0) + (1-\lambda)(1-\lambda-\overline{e})u(c_2(\overline{e}))$$

- First-order condition:

$$\frac{dW(\overline{e})}{d\overline{e}} = u(c_1^*) - \lambda u(0) - (1-\lambda)u(c_2(\overline{e})) + (1-\lambda)(1-\lambda-\overline{e})\frac{dc_2(e)}{d\overline{e}}u'(c_2(\overline{e}))$$

if we serve one more investor at t=1 …

she gets either this …

(if impatient)

…instead of this…

(if patient)

… or this

and all remaining patient investors

will consume less

which we value according to their marginal utility

- To simplify:
  - evaluate derivative at $\overline{e} = e^T$ and recall $c_2(e^T) = c_1^*$
  - assume $u(0) = 0$

- Repeating:

$$\frac{dW(\overline{e})}{d\overline{e}} = u(c_1^*) - \lambda u(0) - (1-\lambda)u(c_2(\overline{e})) + (1-\lambda-\overline{e})(1-\lambda)\frac{dc_2(e)}{d\overline{e}}u'(c_2(\overline{e}))$$

- Becomes:

$$\frac{dW(\overline{e})}{d\overline{e}}\Big|_{\overline{e}=e^T} = \lambda u(c_1^*) + (1-\lambda-e^T)(1-\lambda)\frac{dc_2(e)}{d\overline{e}}\Big|_{\overline{e}=e^T} u'(c_1^*)$$

- If $\lambda \approx 0$, this derivative is negative
  - $\overline{e}^* < e^T$ and there is no bank run equilibrium
  - interpretation: only a short freeze is needed to realize R
- If $\lambda \approx 1$, this derivative is positive
  - $\overline{e}^* > e^T$ and the bank run equilibrium exists
  - if a long freeze is required, government will choose to delay

Takeaways

- Choosing when to freeze deposits is an example where:
  - a strict policy ($\overline{e} = 0$) would create good ex ante incentives
    - by reassuring patient investors
  - but is costly to implement ex post
    - because some impatient investors starve
- If policy makers can commit to a strict policy
  - this choice would achieve financial stability
- If they cannot, investors will expect a lenient response
  - this expectation is a *source* of financial fragility
- An example of <u>time inconsistency</u>
  - classic reference: Kydland and Prescott (JPE, 1977)

References

Diamond, Douglas W. and Phillip H. Dybvig (1983) "Bank Runs, Deposit Insurance, and Liquidity," *Journal of Political Economy* 91: 401-419.

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Policy Response 2: Deposit Insurance

Motivation

- Most countries have some form of deposit insurance
  - often limited to small/medium sized deposits
- Policy has made retail bank runs relatively rare events
  - but has not eliminated them (Argentina, Northern Rock, Cyprus, Greece)
- Want to study this policy in the context of our model
  - again break the analysis into two cases:
    - with commitment (policy chosen at $t = 0$)
    - without commitment (policy chosen at $t = 1$)
- Reading:
  - Diamond and Dybvig (1983, Section V)

2a. Deposit Insurance with Commitment (Diamond and Dybvig, 1983)

- Suppose the government has $\bar{g}$ units of consumption available at $t = 1$
- Both bank and the government follow set rules (for now)
- Bank operates as before
  - makes same choices x^* and c_1^* as the planner
- If bank runs out of storage at $t = 1$ and more investors withdraw:
  - government takes over the bank
  - uses bank's assets together with $\bar{g}$ to:
    - pay up to c_1^* to investors withdrawing at $t = 1$
    - pay up to c_2^* to investors withdrawing at $t = 2$

- If $\bar{g}$ is large enough, govt. can always guarantee (c_1^*, c_2^*)
  - a government with infinite resources is always credible
  - if payments are guaranteed, investors will not run

Q: How large must $\bar{g}$ be to eliminate the run equilibrium?

  - or, how much "fiscal space" does the government need in order to credibly prevent runs through deposit insurance?

- To answer this question, we
  - suppose all other patient investors run ($y_{-i} = 1$)
  - derive the best response of an individual patient investor
    - does he want to join the run? or not?

- Suppose $y_{-i} = 1$
  - would an individual patient investor prefer c_1^* or an even share at $t = 2$?

Q: What is an even share of the bank's assets at $t = 2$ worth?

- Note: govt will use all of $\bar{g}$ before liquidating any investment
- How much investment will be liquidated?
  - extra payments: ec_1^*
  - extra resources available: $\bar{g}$
  - must liquidate:

$$\max\left\{\frac{ec_1^* - \bar{g}}{r}, 0\right\}$$

- Repeating: liquidate $\max\left\{\frac{ec_1^* - \bar{g}}{r}, 0\right\}$ units of investment
- An even share at $t = 2$ is then worth:

$$c_2(e, \bar{g}) = \min\left\{c_2^*, \max\left\{\frac{R\left(x^* - \frac{ec_1^* - \bar{g}}{r}\right)}{1 - \lambda - e}, 0\right\}\right\}$$

- The bank run equilibrium is eliminated if

$$c_2(e, \bar{g}) > c_1^* \quad \text{for all } e$$

or

$$R\left(x^* - \frac{ec_1^* - \bar{g}}{r}\right) > (1 - \lambda - e)c_1^* \quad \text{for all } e$$

- Repeating: $R\left(x^* - \frac{ec_1^* - \bar{g}}{r}\right) > (1 - \lambda - e)c_1^*$ for all e

- Take the limit as $e \to 1 - \lambda$:

$$R\left(x^* - \frac{ec_1^* - \bar{g}}{r}\right) > 0$$

or

$$\bar{g} > (1 - \lambda)c_1^* - rx^*$$

$= (1 - \lambda)\frac{c_2^*}{R}$

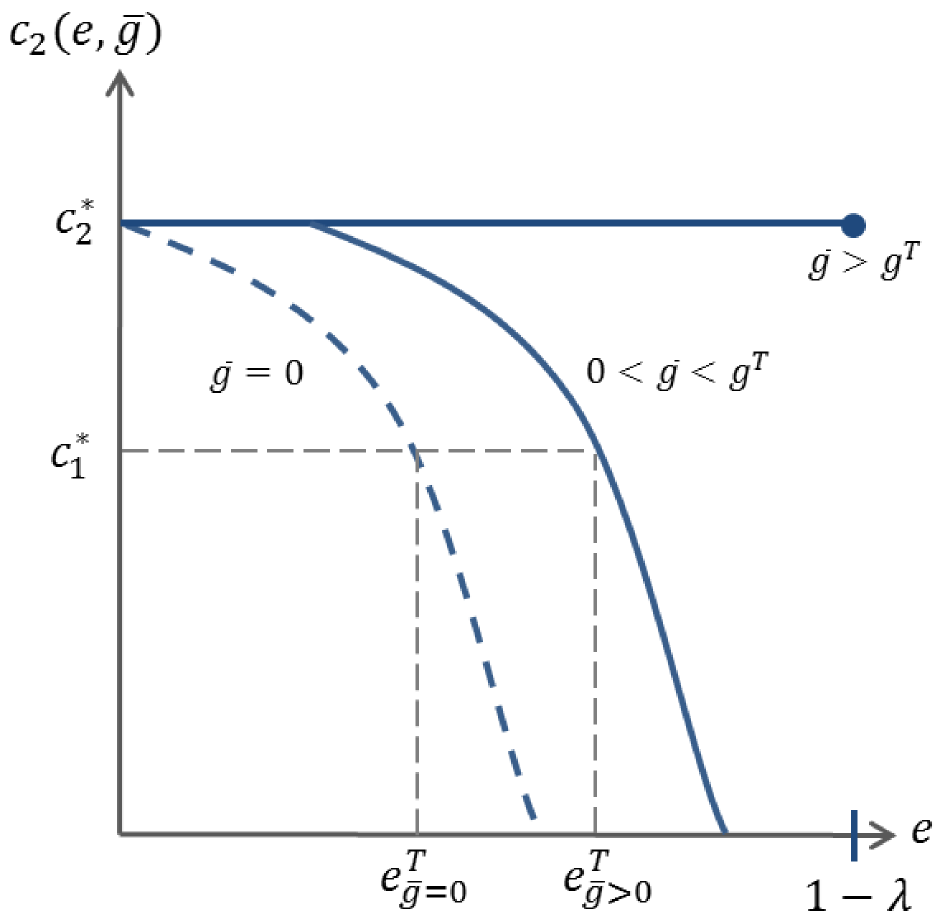
or

$$\bar{g} > (1 - \lambda)\left(c_1^* - \frac{r}{R}c_2^*\right) \equiv g^T$$

for each patient investor

difference between c_1^* and liquidation value of invested assets

Graphically



Result: If govt commits to insure deposits and $\bar{g} > g^T \Rightarrow$ unique Nash equilibrium is $y_i = 2$ for all i

- no bank run occurs in this equilibrium

$\Rightarrow$ no deposit insurance payments are made (**!**)

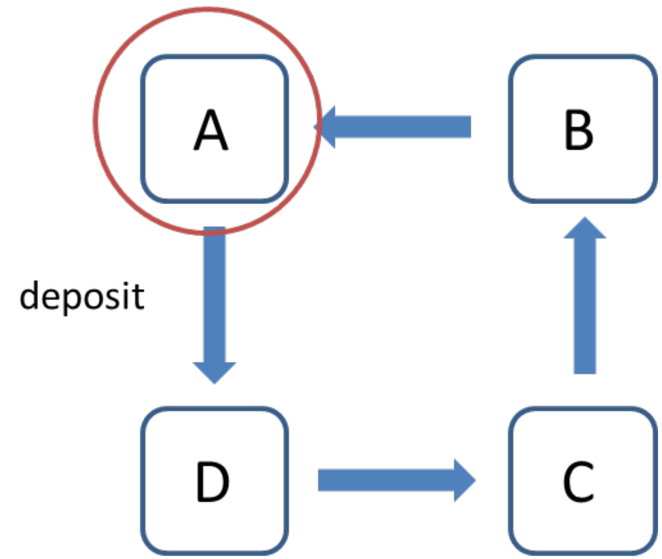
  - policy has no cost in equilibrium

- If $\overline{g} < g^T$, the bank run equilibrium $(y_i = 1)$ also exists
  - government provides partial deposit insurance
  - but some investors receive nothing

- Bottom line: ability of deposit insurance to eliminate bank runs depends critically on the "fiscal space" of the govt.
  - consistent with bad outcomes in Argentina, Cyprus, Greece

A comment

- In practice, DI may reduce fragility even when $\bar{g} < g^T$
- Think of the Allen-Gale model
  - without DI: run on Bank A can cause all banks to fail
  - with DI: if $\bar{g} > g_A^T$, the chain of failures never starts



$\Rightarrow$ DI can effectively prevent runs and contagion with small $\bar{g}$

- But model predicts DI will be ineffective if:
  - there are runs on several banks at once (systemic)
  - or Bank A is very large ("too big to save")

Another comment: the "diabolic loop"

- In practice, the resources available to the government ($\bar{g}$) depends on tax revenue
  - which, in turn, depends on the health of the economy
- When investment is liquidated, tax revenue may fall
- Can imagine a situation where:
  - in normal times, $\bar{g} > g^T \Rightarrow$ DI should be effective
  - but … if a bank run occurs, tax revenue falls
    - government's resources could fall to $\overline{g}_L < g^T$
  - banking system is susceptible to a run <u>because</u> the crisis weakens the government's fiscal position
- Called the "diabolic loop" (several recent papers)

2b. Deposit Insurance without Commitment

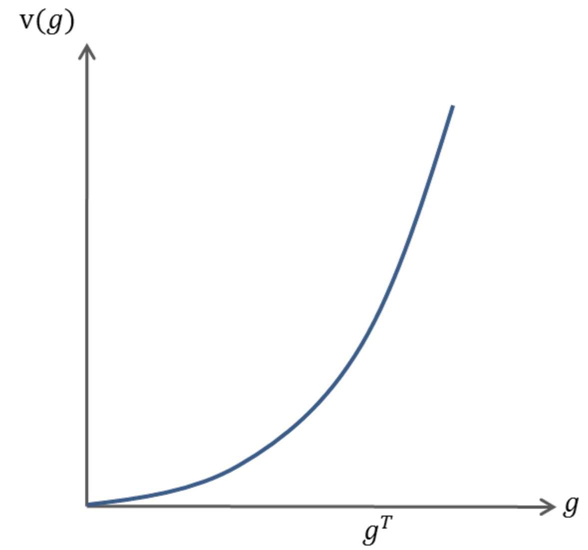
A question

- Assume $\bar{g} > g^T \Rightarrow$ deposit insurance is feasible
- At $t = 0$, govt would like to promise generous coverage
  - "we will spend all of $\bar{g}$ if needed to make depositors whole"
  - if successful, there is no run and the promise is not tested
- But if a run occurs at $t = 1$, govt faces a trade-off
  - would like to help depositors who are facing losses
  - but this may require drastic cuts in spending, social services
- If govt is not willing to spend all of $\bar{g}$ …
  - … patient investors may become nervous and withdraw early

Q: Is the government's promise to insure deposits *credible*?

The expanded withdrawal game

- Introduce a government that chooses how much deposit insurance to provide: $g \in [0, \bar{g}]$
  - government again becomes a player in the game
  - objective: maximize the sum of investors' utilities minus the cost of funds $v(g)$



- Can think of $v(g)$ as representing:
  - lost utility when govt cuts spending, public services
  - lost utility from future taxes if govt is issuing new debt
- Assume: $v(g)$ is increasing and strictly convex; $v'(0) = 0$

- Complete profile of withdrawal strategies:

$$(y, g) \in \{1,2\}_{i\in[0,1]} \times [0, \bar{g}]$$

  - government chooses best response to strategies of investors
  - investors choose best response to other investors and govt.
- Note: there is still a Nash equilibrium with

$$y_i(\omega_i) = 2 \text{ for all } i, \text{ and}$$

$$g = 0 \quad \text{(or anything else)}$$

  - consumption allocation: (c_1^*, c_2^*)
- Intuition: if no patient depositors run …
  - deposit insurance is not needed
  - and, therefore, the choice of g is irrelevant

Fragility

Q: Is there also an equilibrium with $y_i = 1$ for all i?

- Approach to answering this question:
  - find the government's best response to this strategy profile, g^*
  - if $g^* \left\{ \begin{matrix} < \\ > \end{matrix} \right\} g^T$, then answer is $\left\{ \begin{matrix} \text{yes} \\ \text{no} \end{matrix} \right\}$
- To find the govt's best response
  - first: look at fraction of investors served:

$$q(g) = \min\left\{ \underbrace{\frac{rx^* + (1 - x^*) + g}{c_1^*}}, \underbrace{1} \right\}$$

these two terms are equal when $g = g^T$

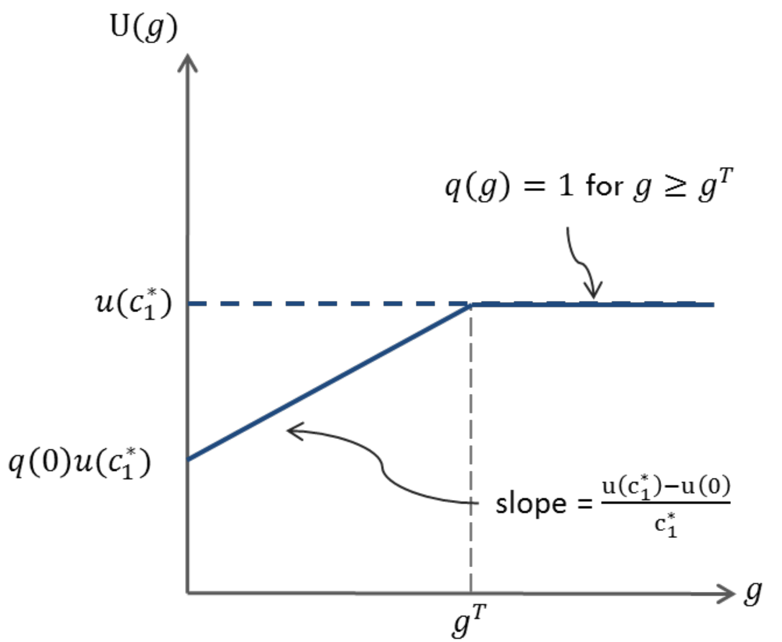
- Note: $q'(g) = \frac{1}{c_1^*}$ for $g < g^T$ and $q(g) = 1$ for $g \geq g^T$

Finding the best response

- Utility of investors

$$U(g) \equiv \begin{cases} \overbrace{q(g)u(c_1^*)}^{\text{served}} + \overbrace{\big(1-q(g)\big)u(0)}^{\text{not served}} \\ \underbrace{u(c_1^*)}_{\text{everyone is served}} \end{cases} \text{ for } g \begin{Bmatrix} < \\ \geq \end{Bmatrix} g^T$$

- Graphically:



Note: no benefit of setting $g > g^T$

- The government's best response solves:

$$\max_{g\in[0,\bar{g}]} \; U(g) - v(g)$$

where:
$U'(g)$ is constant
$v'(g)$ is increasing

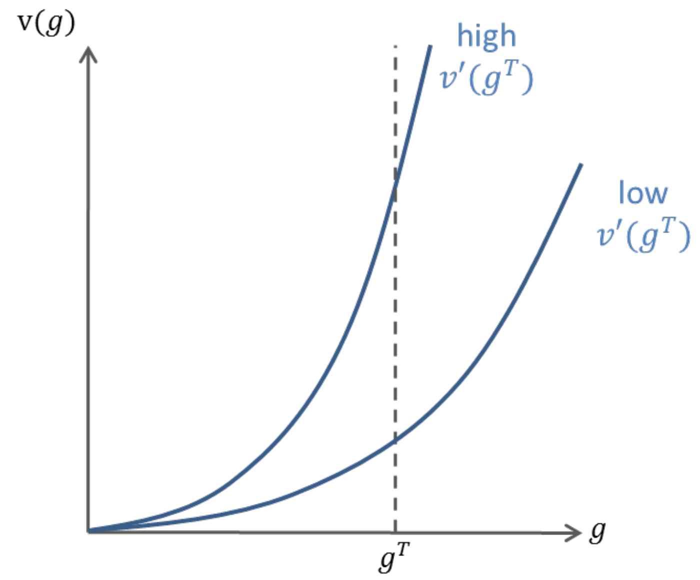
- Solution is either:

$$\frac{u(c_1^*)-u(0)}{c_1^*} = v'(g^*) \;\text{ and } g^* \leq g^T$$

or

$$g^* = g^T \;\text{ and }\; \frac{u(c_1^*)-u(0)}{c_1^*} > v'(g^T)$$

- Depending on parameter values, either case can apply



Result: If $v'(g^T) \leq \frac{u(c_1^*)-u(0)}{c_1^*}$, then the unique Nash equilibrium of the expanded game has $y_i = 2$ for all i.

- implements the efficient allocation (c_1^*, c_2^*)
- no run occurs ⇒ no insurance payments are made
- occurs when function $v(g)$ is relatively flat

- Intuition:
  - if the govt is able to raise/ spend funds at relatively low cost
  - … then investors anticipate govt will be willing to insure deposits in a crisis
  - patient investors are confident; leave money in bank

⇒ deposit insurance is effective in preventing a run

However

Result: If $v'(g^T) > \frac{u(c_1^*) - u(0)}{c_1^*}$, then another Nash equilibrium exists, with $y_i = 1$ for all i.

- a bank run occurs and all investment is liquidated
- government provides "partial" deposit insurance
- but it is not enough to convince patient investors to wait
- occurs when function $v(g)$ is relatively steep

- Point: deposit insurance is perhaps less effective than earlier results indicated
  - question is not how much government can spend
  - but how much it would be willing to spend in a crisis
  - episodes in Iceland (2008) and Cyprus (2012) highlighted this difference

- Another example of <u>time inconsistency</u>
- Suppose $g^* < g^T < \bar{g}$
- If the government could commit at $t = 0$ to set $g \geq g^T$
  - investors would never run $\Rightarrow$ govt will not spend the money
- Without commitment, however:
  - investors anticipate govt will only be willing to spend g^*
  - because of this, patient investors choose to withdraw

$\Rightarrow$ govt actually spends g^* in equilibrium (at cost $v(g^*)$)

- Govt's inability to commit makes everyone worse off
  - even with a well-intentioned, competent government

References and further reading

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Policy Response 3: Narrow Banking
or: replacing banks with mutual funds
(Jacklin, 1987)

- Previous policy responses attempted to <u>stabilize</u> banks
  - keep the basic structure of demand deposits
  - but convince patient depositors to not exercise the option to withdraw

- Our final policy is a proposal to <u>replace</u> banks

- Recall our methodology
  - we found the (full-information) efficient allocation (c_1^*, c_2^*)
  - showed a bank offering demand deposits can implement (c_1^*, c_2^*)
    - but also leads to fragility (when assumption (A1) is satisfied)

Q: Are there other ways to implement (c_1^*, c_2^*)?

- preferably without also creating financial fragility?

- Suppose investors set up a <u>mutual fund</u> instead of a bank
- Rules:

  (i) in exchange for depositing 1 unit at $t = 0$, investors receive:

  - a dividend d at $t = 1$
  - <u>and</u> an even share of the fund's assets at $t = 2$

  (ii) fund places a fraction d of assets into storage

  - and $(1 - d)$ into investment

  $\Rightarrow$ a share at $t = 2$ is worth … $R(1 - d)$

  (iii) allow trade at $t = 1$ of shares in the fund (for goods)

- Idea: impatient investors can sell their shares at $t = 1$…
  - … to patient investors, who have received dividends

Q: Is this mutual fund a desirable arrangement?

- what equilibrium allocation(s) does it lead to?

- Let p = price of a share at $t = 1$
- Impatient investors will sell shares for any $p > 0$
  - each consumes: $c_1 = d + p$
- Patient investors will buy shares if $p \leq R(1-d)$
  - otherwise they would prefer to store the dividend until $t = 2$
  - quantity of shares purchased: $\frac{d}{p}$
  - consume: $c_2 = \left(1 + \frac{d}{p}\right) R(1-d)$

Equilibrium

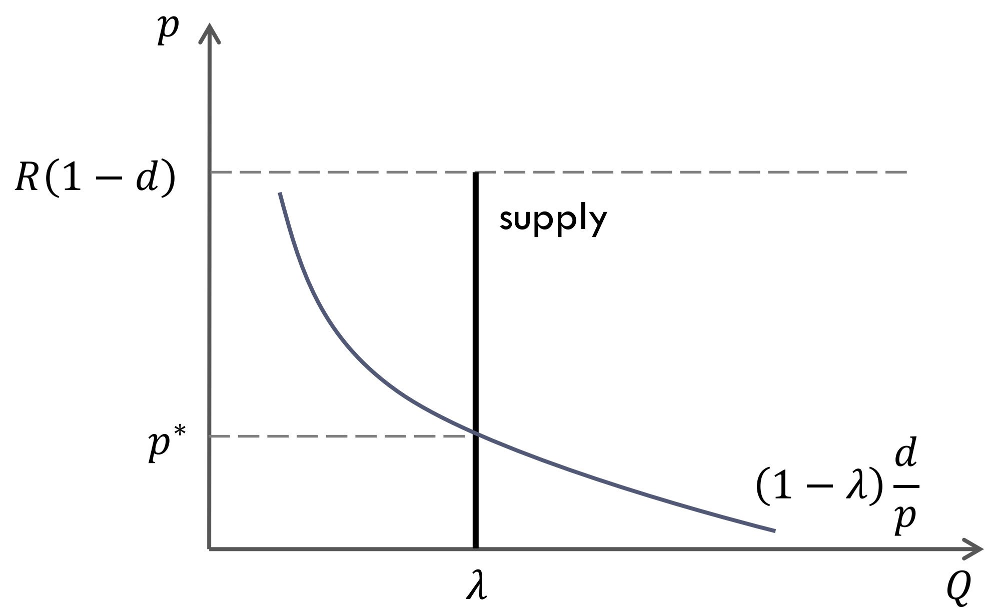
- Market-clearing condition for shares:

$$\underbrace{\lambda}_{\text{supply}} = \underbrace{(1-\lambda)\frac{d}{p}}_{\text{demand}}$$

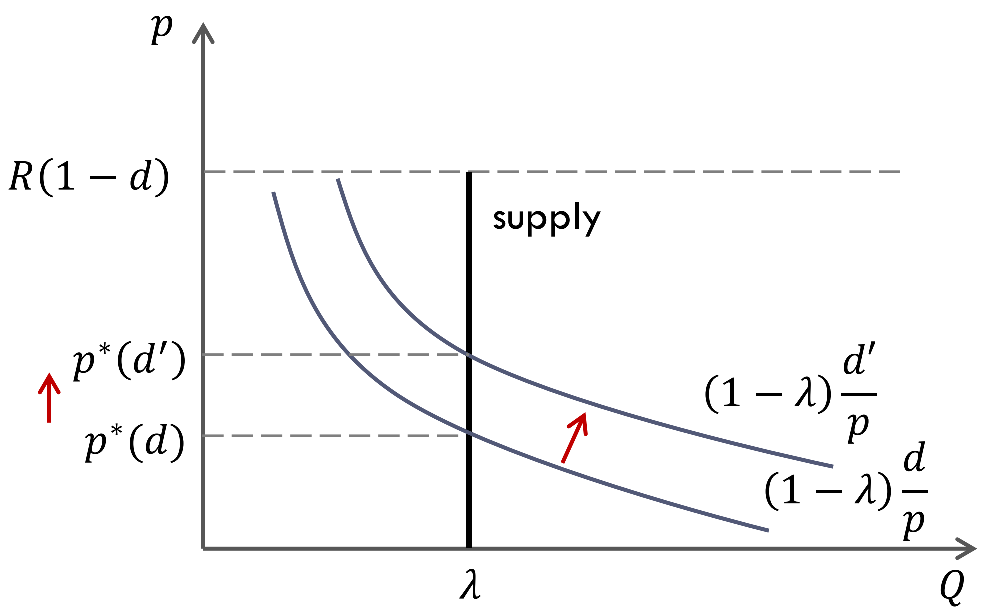
- Solve for: $p^* = \frac{1-\lambda}{\lambda} d$

- If $p^* = \frac{1-\lambda}{\lambda} d < R(1-d)$ …
  - solve for: $d < \frac{\lambda R}{1-\lambda+\lambda R}$

- … then p^* is the unique equilibrium price



- Note: p^* is strictly increasing in d



- Equilibrium consumption levels:

$$c_1 = d + p^*(d) \quad \text{and} \quad c_2 = \left(1 + \frac{d}{p^*(d)}\right) R(1-d)$$

Q: What pairs (c_1, c_2) obtain for different choices of d?

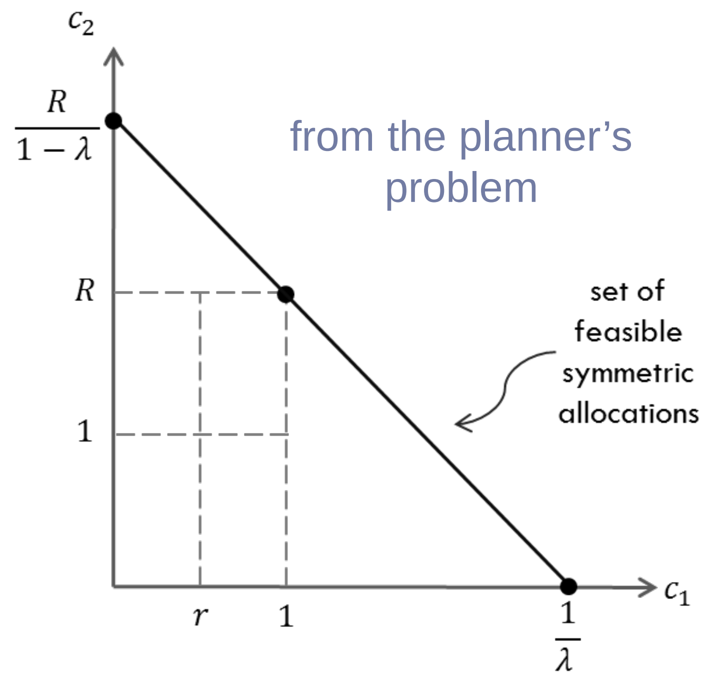
$$c_1 = d + p^*(d) \;= d + \frac{1-\lambda}{\lambda} d \;= \frac{d}{\lambda}$$

$$c_2 = \left(1 + \frac{d}{p^*(d)}\right) R(1-d) \;= \left(1 + \frac{d}{p}\right) R(1-d) \;= \frac{R}{1-\lambda}(1-d)$$

- Note:

$$\lambda c_1 + (1-\lambda)\frac{c_2}{R} = d + (1-d)$$
$$= 1$$

- This looks familiar (**!**)
  - set of feasible symmetric allocations from the planner's problem



- So far we know the allocation …

$$c_1 = \frac{d}{\lambda} \text{ and } \quad c_2 = \frac{R}{1-\lambda}(1-d)$$

- … can be implemented if

$$p^* = \frac{1-\lambda}{\lambda} d < R(1-d)$$

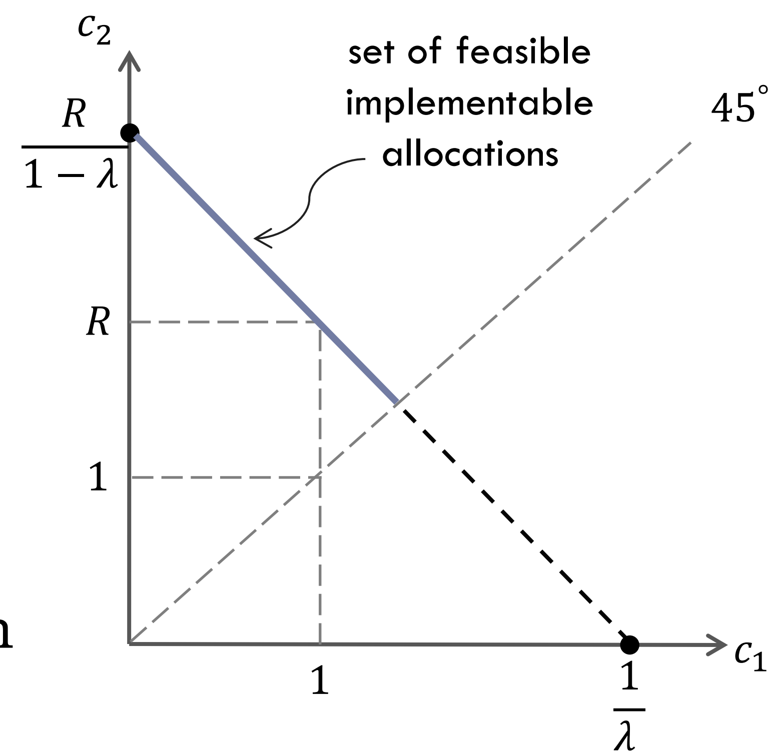
or

$$\frac{d}{\lambda} < \frac{R}{1-\lambda}(1-d)$$

or

$$c_1 < c_2$$

- Recall: the efficient allocation always has $c_1^* < c_2^*$



- How should d be set?
  - easy: want to implement (c_1^*, c_2^*)
- If the rules of the fund set $d = \lambda c_1^*$ …
  - that is, the fund pays out enough in dividends at $t = 1$ for each impatient investor to consume c_1^*
- … then

$$p^* = \frac{1-\lambda}{\lambda} d$$

$$= (1-\lambda) c_1^*$$

- … and

$$(c_1, c_2) = (c_1^*, c_2^*)$$

unique equilibrium of the mutual fund arrangement

full information efficient allocation

Result: If mutual fund sets $d = \lambda c_1^*$, the arrangement implements (c_1^*, c_2^*) as a unique equilibrium.

- The mutual fund brings all of the benefits of banking …
  - effectively does maturity transformation
  - with no early liquidation of investment
- … without the cost of fragility
  - there is a unique equilibrium of the model

Q: Why is there no "run" equilibrium in this case?

- patient investors cannot withdraw directly from the fund …
- but they could choose to sell their share instead of buying

Complements and substitutes

- Recall why the banking arrangement is fragile
  - suppose other patient investors withdraw early
  - under assumption (A1), $c_2(e)$ is a decreasing function
    - why? Because the bank is liquidating investment to pay for the additional withdrawals

  $\Rightarrow$ withdrawing early becomes more attractive

- This is an example of <u>strategic complementarity</u>

- With the mutual fund arrangement:
  - suppose other patient investors sell shares rather than buy
  - then the price p will fall …
  - which makes selling <u>less</u> attractive $\rightarrow$ no complementarity

Caveats

1. Analysis assume a perfect (Walrasian) market
   - price adjusts so that supply = demand
   - and all investors trade at the same price

- If markets are imperfect, market-based runs can occur
  - Bernardo and Welch (QJE, 2004)
- Idea: suppose investors sell shares sequentially, and
  - as more sales occur → the market price decreases, and
  - investors may be forced to sell at the end of $t = 1$
- Then a patient investor with the opportunity to sell early
  - may take it -- before the price decreases

2. Results are different for more general preferences
   - Jacklin and Bhattacharya (JPE, 1988)

- We saw: set of implementable allocations for the mutual fund = (relevant part of) planner's constraint set

- Suppose investors instead have preferences like:

$$u(c_1) + \rho_i u(c_2)$$

$$\text{where } \rho_i = \begin{Bmatrix} \rho_L \\ \rho_H \end{Bmatrix} \text{ if investor } i \text{ is } \begin{Bmatrix} \text{impatient} \\ \text{patient} \end{Bmatrix}$$

- In a more general setting, the feasible sets may satisfy:

$$\text{Mutual Fund} \subset \text{Bank} \subset \text{Planner}$$

   - tradeoff: bank offers better allocation, but fragility

3. Transacting with mutual fund shares may be more difficult than with deposits

- Gorton and Pennacchi (JoF, 1990)

- In our model, investors put goods into the bank and receive goods back when they withdraw
  - they then directly consume those goods
- In reality, we use bank deposits for transactions
  - write a check or use your debit card
- How would you pay a merchant from the mutual fund?
  - would he/she be willing to accept the shares?
  - or how quickly can you sell the shares and pay with cash?

John Cochrane

“Stopping Banking Crises Before They Start”
WSJ Op Ed

- “At its core, the recent financial crisis was a run. The run was concentrated in the "shadow banking system" of overnight repurchase agreements, asset-backed securities, broker-dealers and investment banks, but it was a classic run nonetheless.”
- “Runs are a pathology of financial contracts, such as bank deposits, that promise investors a fixed amount of money and the right to withdraw that amount at any time.”
- “Rather than try to regulate the riskiness of bank assets, we should fix the run-prone nature of their liabilities.”
- “Some people will argue: Don't we need banks to "transform maturity" and provide abundant "safe and liquid" assets for people to invest in? Not anymore.”
- “Modern financial technology surmounts the economic obstacles that impeded this approach in the [past].”

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