Problem Set 5

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reserve requirement $0 < k < 1$

1. " Fractional reserve banking "

Banks	Deposits	Loans
First bank	M_0	$(1-k)M_0$
Second bank	$(1-k)M_0$	$(1-k)(1-k)M_0$
Third bank	$(1-k)(1-k)M_0$	...
...	...	...
Nth bank	$(1-k)^{N-1}M_0$	$(1-k)^N M_0$

First bank

	A	L
loans —	$(1-k)M_0$	M_0
reserves —	kM_0	

Total deposits ?

$$M_1 = M_0 + (1-k)M_0 + \cdots + (1-k)^{N-1}M_0$$

$$= \frac{1-(1-k)^N}{k} M_0$$

2. $\lim_{N \to +\infty} M_1 = \frac{1}{k} M_0$

$k = 0.1$

$M_1 = 10 M_0$

banks are "creating" money !

"high powered money"

Comment ?

2. Period 0

	A	L
loan	L	D
ins.	P	E

Period 1

	A	L
return	$\tilde{L}$	D
ins.	$\tilde{S}$	$\tilde{E}$

1. a) Balance sheet in $t=0$

$$\left.\begin{aligned} L + P &= D + E \\ P &= \phi D \end{aligned}\right\} \Rightarrow D = \frac{L-E}{1-\phi}.$$

b) L^{max} ?

$$\left.\begin{aligned} \uparrow L \to \uparrow D \to \uparrow P = \phi D \\ P \le E \end{aligned}\right\} \Rightarrow \left.\begin{aligned} P^{max} &= E \\ L + P &= D + E \\ P &= \phi D \end{aligned}\right\}$$

$$\Rightarrow L^{max} = \frac{E}{\phi}.$$

2. at $t = 1$.

$$\tilde{S} = \begin{cases} \text{if } \tilde{L} \ge D, & 0 \\ \text{if } \tilde{L} < D, & D - \tilde{L} \end{cases}$$

cover the diff

shareholders' return ?

$\boxed{\Pi}$ = $\tilde{E} - E$ =

object

- if $\tilde{L} \ge D$, $\tilde{S} = 0$

$\tilde{E} = \tilde{L} + \tilde{S} - D$

$= \tilde{L} - D$

$\tilde{E} - E = \tilde{L} - D - E = \tilde{L} - \frac{L-E}{1-\phi} - E.$

- if $\tilde{L} < D$, $\tilde{S} = D - \tilde{L}$

$\tilde{E} = \tilde{L} + \tilde{S} - D$

$= 0$ ← wiped out

$\tilde{E} - E = -E$

3. $\tilde{L} = \begin{cases} (R+\Delta)L & \text{prob. } \frac{1}{2} \\ (R-\Delta)L & \text{prob. } \frac{1}{2} \end{cases}$ $R > 1$

$(R - 1 < \Delta < 1)$

banks don't need bailout ← lower side $\tilde{L} = (R-\Delta)L$

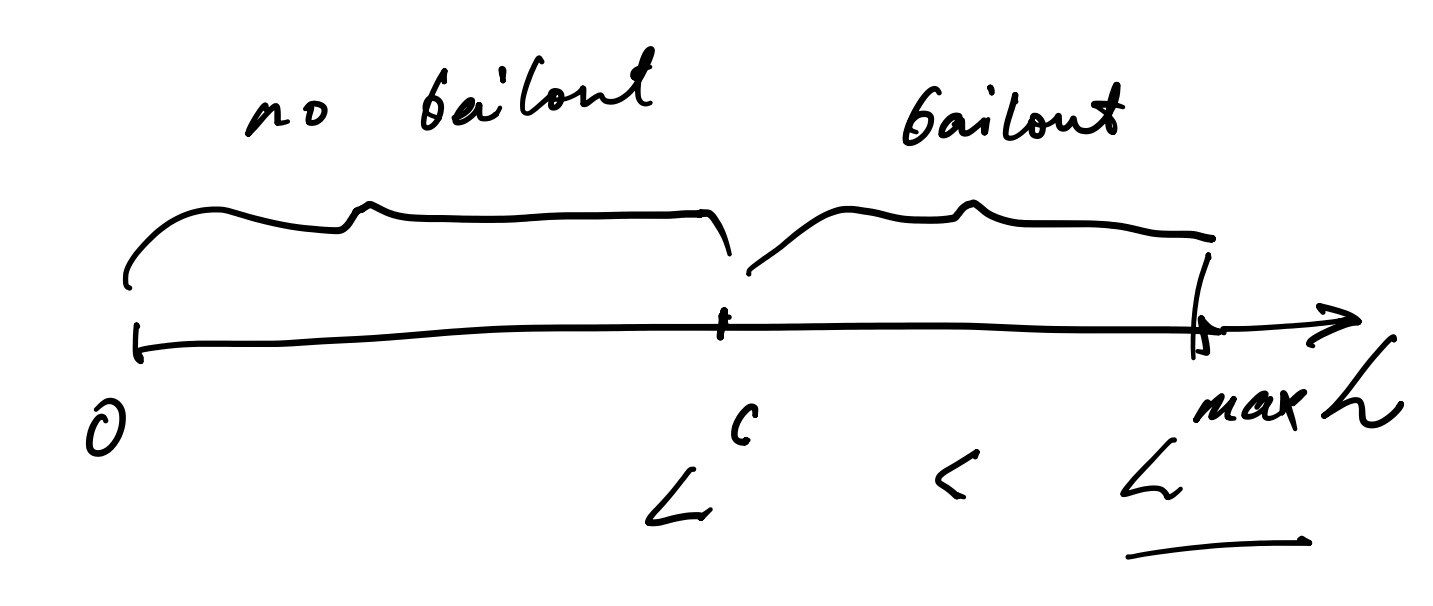
$$\tilde{L} = (R-\Delta)L \ge D = \frac{L-E}{1-\phi}$$

$$\Rightarrow L \le \frac{E}{1-(1-\phi)(R-\Delta)} = L^c$$

$R - \Delta < 1$

$$L^c = \frac{E}{1-(1-\phi)(R-\Delta)} < \frac{E}{1-(1-\phi)\cdot 1} = \frac{E}{\phi} = L^{max}$$

4. $E[\Pi]$? depends on whether needs bailout



(1) if $0 < L \le L^c$, there's no bailout

$E[\Pi_1] = E[\tilde{E} - E]$ ↙ $\tilde{S} = 0$

$= \frac{1}{2}[(R+\Delta)L - D] + \frac{1}{2}[(R-\Delta)L - D]$

$- E$

$= RL - D - E$

$= RL - \frac{L-E}{1-\phi} - E$

(2) if $L^c < L \le L^{max}$? bailout on the downside

$E[\Pi_2] = E[\tilde{E} - E]$

$= \frac{1}{2}\left[(R+\Delta)L - D - E\right] + \frac{1}{2}[-E]$

upside, no bailout, $\tilde{S} = 0$ — downside, bailout, wiped out $\tilde{S} = D - \tilde{L}$

$= \frac{1}{2}\left[(R+\Delta)L - \frac{L-E}{1-\phi}\right] - E$

D

$$L \to \begin{cases} \text{no bailout}, & 0 \le L \le L^c \\ \text{bailout} & L^c < L \le L^{max} \end{cases}$$

Δ ? ① $\frac{\partial E[\Pi_1]}{\partial \Delta} = 0$ shareholder's value doesn't depend on Δ

② $\frac{\partial E[\Pi_2]}{\partial \Delta} > 0$ — value increases with Δ !

upside $\Delta \to$ shareholders

downside $\Delta \to$ insurance !

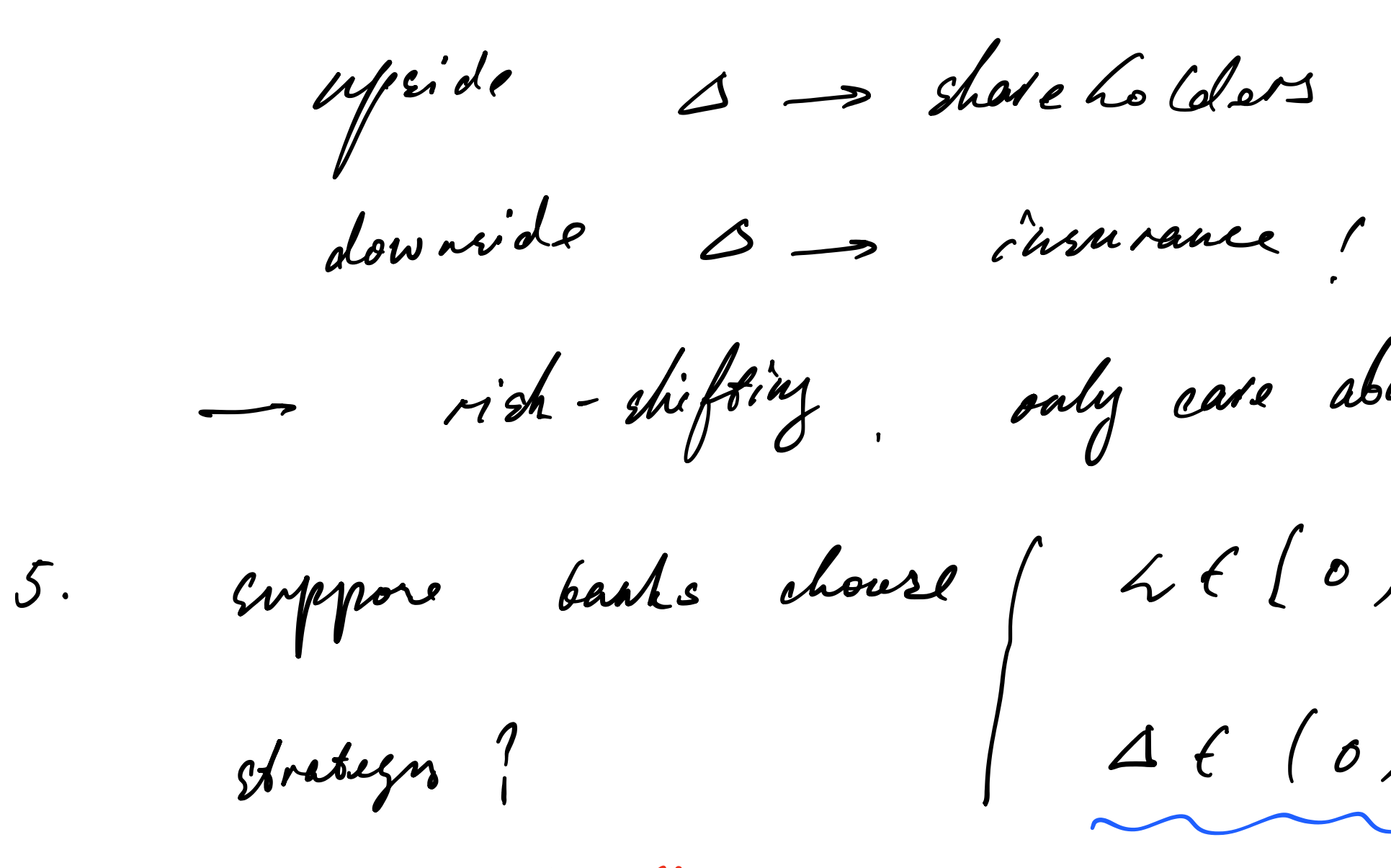
→ risk-shifting. only care about upside

5. suppose banks choose strategy ? $L \in [0, L^{max}]$, $\Delta \in (0, 1)$

Regularity restrictions :

assume $\frac{\partial E[\Pi_1]}{\partial L} \ge 0$, $\frac{\partial E[\Pi_2]}{\partial L} \ge 0$

$\Rightarrow R + \Delta > R \ge \frac{1}{1-\phi}.$



choose no bailout only if

$$E[\Pi_1] > E[\Pi_2]$$

$$\left.\begin{aligned} E[\Pi_1(L^c, \Delta)] &> E[\Pi_2(L^{max}, 1)] \\ L^c &= \frac{E}{1-(1-\phi)(R-\Delta)} \\ L^{max} &= \frac{E}{\phi} \end{aligned}\right\} \Rightarrow$$

$$\frac{\Delta}{1-(1-\phi)(R-\Delta)} > \frac{R}{2\phi} \quad (*) \text{ no bailout condition}$$

$\phi \in (0, 1)$

$\frac{\partial E[\Pi_1]}{\partial E} = \frac{\phi}{1-\phi} > 0$ always !

$\frac{\partial E[\Pi_2]}{\partial E} = \frac{1}{2} \cdot \frac{1}{1-\phi} - 1$ < 0 if $\phi < 0.5$; > 0 if $\phi > 0.5$

6. ϕ

$$\left.\begin{aligned} \phi \uparrow \text{ else equal} \to \uparrow P = \phi D \\ \text{for bailout banks, } P = E \end{aligned}\right\} \Rightarrow$$

$$\left.\begin{aligned} E \uparrow \\ \frac{\partial E[\Pi_2]}{\partial E} < 0 \text{ if } \phi < 0.5 \end{aligned}\right\} \Rightarrow E[\Pi_2] \downarrow$$

$\Rightarrow$ no-bailout condition (*) more likely to hold, or, banks choose no-bailout strategy !