# Economics of Banking
# Lecture 19

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**Capital Regulation**

- Stricter capital regulation may not increase capital.
- Basel rules (recapitulation)
- Capital regulation without regulators?

# Banks acting strategically

Three periods of time $t = 0, 1, 2$.

Two banks $A$ and $B$. Take deposits 1 and invest over 1 period.

Outcome $y$ with probability $\pi$, 0 otherwise.

Non-banks get a net payoff of $y - \Delta$ from investment

Bank's payoff is reduced by $\Delta_1$ if it invests in the same industry as the other bank.

– but bank *managers* get benefit $b$ from investment in the same industry

# Incentives for managers

Bank managers get a share $\theta$ of the profits.

To induce investment in different industries, we must have

$$\pi\theta(y-1) \geq \pi[\theta(y-\Delta_1-1)+b]$$

Gives minimal share $\overline{\theta} = \dfrac{b}{\Delta_1}$ for avoiding moral hazard

After one period, some of the banks may have had failure $F$, others success $S$.

If banks are bailed in, regulator demands a share $\beta$ of next-period profits. There are three cases to be considered:

# What happens at $t = 1$?

**1.** *SS*: both banks proceed to the next period, repeating the investment..

**2.** *SF* or *FS*: Assume *SF*. Then *A* may buy the assets of *B*.

The price at least $P = \pi(y - \Delta) - 1$ (non-bank's net payoff minus reimbursement of depositors from 0).

If this is $< 1$ regulator will prefer that *A* buys *B* (since otherwise it must reimburse depositors), and *A* can afford this since

$$y - 1 > \pi(y - \Delta) - 1$$

# Bail-out

**3.** *FF*: Again three possibilities:

(a) Both are sold: Non-banks pay $2P$ and deposit insurance: $2 - 2P$,

Net result for society is $2P - c(2 - 2P)$, where $c$ is cost of public intervention.

(b) One bank sold, the other bailed out: Net result for society is $\pi y - 1 + P - c(2 - P)$.

(c) Both are bailed out, net result $2(\pi y - 1) - 2c$.

# First result:

Let $\Delta^* := \dfrac{c(\pi y - 1)}{\pi(1 + c)}$.
*If* $\Delta \geq \Delta^*$, *then both banks are bailed out,*

*If* $\Delta < \Delta^*$, *both are sold.*

Consider now the *next* period: either there are no banks or both survive.

Surviving banks can choose fully correlated ($\rho = 1$) or uncorrelated ($\rho = 0$) investment.

# Optimal choice of bank

Checking the expected payoff in both cases, one can summarize all findings as follows:

*Let* $\beta^* = 1 - \dfrac{\pi\Delta}{\pi y - 1}$. *Then:*

*If* $\Delta < \Delta^*$, *both banks are liquidated in FF, and the new investments are uncorrelated.*

*If* $\Delta \geq \Delta^*$, *both are bailed out, and*

- *for* $\beta^* \leq 1 - \overline{\theta}$, *banks choose* $\rho = 0$ *for* $\beta^* \leq \beta \leq 1 - \overline{\theta}$, *and* $\rho = 1$ *for* $\beta < \beta^*$,
- *for* $\beta^* > 1 - \overline{\theta}$, *banks will always choose* $\rho = 1$.

# Measuring TBTF

Given $n$ banks, state of bank $i$ described $\tilde{x}_i$ (
A crisis level of $\tilde{x}_i$ could be $\hat{x}_i = \text{VaR}_{1-p}(\tilde{x}_i)$, for $p$ either 1% or 0.1%.

This gives an indicator of the systemic importance of bank $i$: The conditional probability that some other bank fails given that $i$ is in trouble,

$$\text{PO}_i(p) = \text{P}\left\{\exists j \neq i : \tilde{x}_j > \text{VaR}_{1-p}(\tilde{x}_j) \,\middle|\, \tilde{x}_i > \text{VaR}_{1-p}(\tilde{x}_i)\right\}.$$

This measure may however be insufficient: Banks may influence each other in many ways.

We would need to know how many of the other banks could get into trouble.

# Systemic impact

A measure which takes this into account is the *systemic impact index* (SII)

$$\mathrm{SII}_i(p) = \mathrm{E}\left[\sum_{j=1}^{n} 1_{\tilde{x}_j > \mathrm{VaR}_{1-p}(\tilde{x}_j)} \middle| \tilde{x}_i > \mathrm{VaR}_{1-p}(\tilde{x}_i)\right],$$

(the expected number of banks that will fail as a consequence of the failure of bank $i$)

Alternatively, one may consider interdependence of banks from the opposite angle,

Define the *vulnerability index* VI for bank $i$,

$$\mathrm{VI}_i(p) = \mathrm{P}\left\{\tilde{x}_i > \mathrm{VaR}_{1-p}(\tilde{x}_i) \,\middle|\, \exists j \neq i : \tilde{x}_j > \mathrm{VaR}_{1-p}(\tilde{x}_j)\right\},$$

(the conditional probability that $i$ gets in trouble given that some other bank is in crisis).

# Regulation versus no regulation

One period investment with payoff is $y$ if success, otherwise 0.

Loan contract: Repayment $r_L$;

Loan market is competitive, borrower receives any surplus.

Bank chooses equity $k$ which costs $r_E \geq 1$, $1 - k$ at deposit rate $r_D$.

Bank also chooses probability of success (monitoring) at a cost $q^2/2$.

# No regulation

The level of monitoring is set so as to maximize expected profits

$$\Pi = q(r_L - (1-k)r_D) - kr_E - \frac{1}{2}q^2,$$

with 1st order conditions

$$q = \min\{r_L - (1-k)r_D, 1\}.$$

Monitoring effort is increasing in $r_L$ and $k$ but decreases in $r_D$.

If depositors expect $q$, then $qr_D = 1$. Maximize $B = q(y - r_L)$ subject to

$$q = \min\{r_L - (1-k)r_D, 1\},$$
$$qr_D = 1.$$

# Equilibrium value of $k$

Assume $r_E \geq 1$:

If $q < 1$, then from $q = r_L - (1-k)r_D$ we get that increasing $q$ raises $\Pi \uparrow$ without decreasing $B$, and reducing $r_L$ gives larger $B$, so $q = 1$, $r_D = 1$, and the participation constraint for the bank becomes

$$r_L - 1 + k - kr_E - \frac{1}{2} = 0$$

(positive profit could be used to reduce $r_L$ so it must be 0). From $1 = q \leq r_L - (1-k)$ one has $r_L \geq 2 - k$, inserting gives $k \geq \frac{1}{2r_E}$.

(In order to have low $r_L$ but zero profits, the bank owners must take the gain out as payment for equity use)

# With regulation

Introduce regulator: Set $k$ so as to maximize a social welfare

$$B+\Pi = q(y-r_L)+q(r_L-(1-k)r_D)-kr_E-\frac{1}{2}q^2 = q(y-(1-k)r_D)-kr_E-\frac{1}{2}q^2.$$

For $y \geq 2$, the capital ratio $k$ may be chosen as 0,

(Banks' gain with $r_E = 2$ is large enough to induce $q = 1$)

If $y < 2$, capital ratio is $> 0$, but $q$ may be $\leq 1$.

Conclusion: *The market will force a higher capital ratio on the banks than that determined by a welfare maximizing regulator. Without regulation, equity is a cost to the bank which must be paid by too high loan rates, so it is kept*