Bank Regulation when both Deposit Rate Control and Capital Requirements are Socially Costly

Carsten Krabbe Nielsen

Gerd Weinrich

$^1$Istituto di Politica Economica, Catholic University of Milan

$^2$Dipartimento di Discipline matematiche, Finanza matematica ed Econometria, Catholic University of Milan

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1. Motivations

Regulation of banks: aims to reduce moral hazard issues, i.e. the propensity of banks to take too large risks.

Literature: has explained

- *deposit rate control* (ceiling on interest rate offered to depositors)

and

- *capital control* (minimum requirements for bank capital)

as alternative regulatory instruments.

Stylized facts:

- most developed countries have moved from regimes with interest control to capital control;

- this has been followed by a reduction in the number of banks (consolidation) and increasing interest rates.
Two important theoretical contributions comparing the two regimes:
- Hellmann, T., K. Murdock and J. Stiglitz (AER, 2000), and
Both in favour of interest control.
Why?
Bank capital is costly, so capital control is costly. But no explicitly modeled costs of interest rate control.
Thus: in these papers capital control never Pareto-dominates interest rate control, hence there is no explanation of the facts.
In our contribution: *both* regimes are costly.

As in the papers cited, bank capital is socially costly since its cost is higher than the return it would earn when used by the bank.

In our paper only: interest rate control is socially costly because it increases the profits of banks and hence leads to excess entry (excess capacity) in the banking sector.

Main result: there are reasonable parameter constellations such that capital control is preferable to interest control, thus explaining the facts.
2. The Model

We use Repullo’s (2004) model, but where Repullo assumes a fixed number of banks, we let it be endogenously determined.

The main ingredients of Repullo’s (and our) model:

- General Equilibrium, infinite horizon, Salop model: continuum of risk-neutral potential OLG depositors on the unit circle, each with "transportation costs" $\mu$ and one unit of "money" to deposit, monopolistic competition among banks.

- Moral hazard: risk-neutral banks can choose between a risky project (with lower expected returns) and a safe project (with higher expected returns) and choice is unobservable by outsiders.

- Deposit insurance, so depositors do not care about the choice of the banks.

- Banks which are bankrupt are closed down and replaced by new banks.
What we add to Repullo’s model:

- Free entry, the number $n$ of banks now becomes endogenously determined.
- Set-up costs $C > 0$, necessary to start a new bank.
- Consumers have $D > 0$ units of "money" to deposit.

Zero expected profit condition then determines the number of banks in equilibrium.

When comparing the welfare effects of different regimes the number of banks now becomes an important factor:

- Too few banks is costly because it increases the transportation costs of depositors.
- Too many banks is costly because of the costs associated with setting up banks.
Moral hazard and incentives: the basic idea.

Safe project: delivers return $\alpha$ with probability 1.

Risky project: delivers return $\gamma > \alpha$ with probability $1 - \pi$ and $\beta > -1$ with probability $\pi$.

Safe project is welfare maximizing: $\alpha > (1 - \pi)\gamma + \pi \beta$, i.e. $\pi > (\gamma - \alpha)/(\gamma - \beta) =: \pi$.

A bank operating for one period only and with none of its own capital invested has an expected return when investing the deposits $D$ and offering deposit rate $r_j$ equal to:

- $D(\alpha - r_j)$ from safe project and

- $D(\gamma - r_j)(1 - \pi)$ from risky project (assuming it is bankrupt in the bad outcome).

For $r_j$ sufficiently large the bank thus prefers the risky project.
2. The Model

*Prudent equilibrium:* all banks use the safe project

*Gambling equilibrium:* all banks use the risky project

**Problem:** not for all $\pi > \bar{\pi}$ does there exist a prudent equilibrium, but there is $\tilde{\pi}_0 > \bar{\pi}$ such that

$$\exists \; P\text{-equilibrium} \iff \pi \geq \tilde{\pi}_0$$

$$\exists \; G\text{-equilibrium} \iff \pi \leq \tilde{\pi}_0$$

Avoid $G$-equilibrium by imposing capital requirements and/or deposit interest ceilings.
The Game

Date 0:

- The capital requirement or the deposit rate ceiling is determined by the regulator.

Date 1:

- First stage: potential banks decide to enter or not.
- Second stage: with the number $n$ of banks being given, a symmetric, subgame perfect Nash equilibrium in terms of investment choice and deposit rate (possibly restricted) is reached.

Date $t > 1$:

- If a bank is declared bankrupt, a new bank immediately replaces it. In the second stage at date $t$, $n$ is taken as given and the game is as in the second stage at date 1.
3. Capital requirements

Equilibrium with the prudent asset: consider

\[ V_P := \max_{r_j} \left\{ -k \mathcal{D}(r_j, r, n) + \frac{1}{1 + \rho} [\alpha - r_j + (1 + \alpha)k] \mathcal{D}(r_j, r, n) + \frac{1}{1 + \rho} V_P \right\} \]

where

- \( k \) = amount of capital per unit of deposits
- \( \mathcal{D}(r_j, r, n) := \frac{1}{n} D + \frac{r_j - r}{\mu} D^2 \) = demand for deposits of bank j
- \( \rho \) = cost of outside capital = bank shareholders’ discount rate > \( \alpha \)

\[ \Rightarrow \]

- 1° term = equity contribution of the bank’s shareholders at date t
- 2° term = discounted value of the bank equity capital at date t+1 = assets - liabilities
- 3° term = discounted value of remaining open at date t+1
Solution: in symmetric equilibrium no profitable deviation and

\[ r_j = r = \alpha - \frac{\mu}{nD} - (\rho - \alpha) k =: r_P, \quad V_P = \frac{\mu}{\rho n^2} \]

\[ V_P \overset{!}{=} C \Rightarrow \]

\[ n = \sqrt{\frac{\mu}{\rho C}} =: n_P \]
2. The Model

Equilibrium with the gambling asset:

\[ V_G := \max_{r_j} \left\{ -k\mathcal{O}(r_j, r, n) + \frac{1 - \pi}{1 + \rho} \left[ \gamma - r_j + (1 + \gamma)k \right] \mathcal{O}(r_j, r, n) + \frac{1 - \pi}{1 + \rho} V_G \right\} \]

Solution: in symmetric equilibrium

\[ r_j = r = \gamma - \frac{\mu}{nD} - \left[ \frac{1 + \rho}{1 - \pi} - (1 + \gamma) \right] k =: r_G, \quad V_G = \frac{(1 - \pi) \mu}{(\rho + \pi) n^2} \]

\[ V_G \overset{!}{=} C \Rightarrow \]

\[ n = \sqrt{\frac{(1 - \pi) \mu}{(\rho + \pi) C}} =: n_G \]

Note: \( n_G < n_P \)
With capital requirements, when do there exist P-equilibria and/or G-equilibria?

Answer:

For any $\pi > \bar{\pi}$, there exists $\tilde{k}(\pi)$ such that:

- $\exists$ P-equilibrium $\iff k \geq \tilde{k}(\pi)$
- $\exists$ G-equilibrium $\iff k \leq \tilde{k}(\pi)$
2. The Model

Equilibria in presence of capital requirement
What can be said about welfare?

\[ W^* = (1 + \alpha)D - \frac{\mu}{4n^*} - \rho n^* C \]

where \( n^* \) maximizes \((1 + \alpha)D - \frac{\mu}{4n} - \rho nC\)

\[ W_P(k) = (1 + \alpha)(1 + k)D - \frac{\mu}{4n_P} - \rho n_P C - (1 + \rho)kD \]

\[ W_G(k, \pi) = (1+(1 - \pi)\gamma+\pi\beta)(1 + k)D - \frac{\mu}{4n_G} - (\rho + \pi)n_G C - (1 + \rho)kD \]

Can show:

- \( n^* < n_P \)
- for any \( \pi > \bar{\pi} \) \( \exists! \hat{k}(\pi) \) s.t.

\[ W_P(k) \geq W_G(0, \pi) \iff k \leq \hat{k}(\pi) \]
\[ W_P(k) \leq W_G(0, \pi) \iff k \geq \hat{k}(\pi) \]
2. The Model

\[ W_P := W_P(k) \]
\[ W_G := W_G(0, \pi) \]

Welfare in case of prudent and gambling equilibrium

\[ W_P < W_G \]
\[ W_P > W_G \]
2. The Model

\[ W_P := W_P(k) \]
\[ W_G := W_G(0, \pi) \]

Meaningful regulation by means of capital requirement
Result:

There exists an open set of reasonable parameter values such that there exists $\pi^* < \bar{\pi}_0$ such that for $\max \{\pi^*, \bar{\pi} \} < \pi < \bar{\pi}_0$ capital requirement is a meaningful regulation policy.
4. Interest control

Deposit rate ceiling $\bar{r}$ determined by the regulator.

Aim: induce banks to invest in the prudent asset because with a ceiling on interests the safe asset becomes more attractive.

Recall:

$$\text{expected return} = \begin{cases} \mathcal{D}(\alpha - r_j) & \text{from safe investment} \\ \mathcal{D}(\gamma - r_j)(1 - \pi) & \text{from risky investment} \end{cases}$$

Banks are free to enter the market

$\Rightarrow$ the increased prospective profit resulting from interest rate ceilings may lead to more banks entering the market;

$\Rightarrow$ the cost of the interest rate ceiling is higher total set-up costs (with capital requirement the cost derives from the cost of capital put up by the banks).
Assume $k = 0$ and let $\overline{R}_P(\bar{r}) := \min\{\bar{r}, r_P\} \Rightarrow$

value of being in the market in a prudent equilibrium with $n$ banks is

$$V_P = \frac{1}{1 + \rho} \left[ \alpha - \overline{R}_P(\bar{r}) \right] \frac{D}{n} + \frac{1}{1 + \rho} V_P$$

$$\Rightarrow$$

$$V_P = \max \left\{ \frac{\mu}{\rho n^2}, \frac{\alpha - \bar{r}}{\rho n} D \right\}$$

$$V_P \overset{!}{=} C \Rightarrow$$

$$\overline{n}_P(\bar{r}) := \max \left\{ \frac{\alpha - \bar{r}}{\rho C} D, n_P \right\} \geq n_P$$
Existence of equilibrium

Given \( \overline{R}_P(\overline{r}) = \min\{\overline{r}, r_P\} \), it must not be profitable to deviate in either of the following ways:

(i) A bank already in the market charges another interest rate but continues to use the prudent asset.

(ii) A bank already in the market uses the gambling asset instead of the prudent asset and charges another interest rate.

Denote by \( \overline{r}^* \) the interest rate that the deviating bank would choose in case (ii). We show: \( \overline{r}^* \geq r_P \).

Then there are two possible types of equilibria with interest ceiling:

(i) \( \overline{r} < r_P \), the ceiling is binding for all banks.

(ii) \( r_P \leq \overline{r} < \overline{r}^* \), the ceiling is binding for a deviator only.
Existence of prudent equilibria with interest ceiling:
A: with binding ceiling
B: with non-binding ceiling
4. Interest control

\[ \bar{r} \]

\[ \bar{r}^* \]

\[ r_P \]

\[ \pi \]

\[ \pi^* \]

\[ \pi_1 \]

\[ \pi_2 \]

\[ \pi_3 \]

\[ \tilde{\pi}_0 \]

\[ A \]

\[ B \]

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4. Interest control

\[ W^* W_P(0) \]

\[ W_G \]

\[ W_P \]

\[ \pi^* \pi_1 \pi_2 \pi_3 \pi_0 \]

\[ n \]

\[ \bar{n}_P \]

\[ n_P \]

\[ n_G \]

\[ n^* \]
4. Interest control

\[ \bar{r} = r_P \]

\[ \hat{k} = \tilde{k} \]

\[ \pi^* \]

\[ \pi_1 \]

\[ \pi_2 \]

\[ \pi_3 \]

\[ \tilde{\pi}_0 \]

\[ 0 \]

\[ 0.25 \]

\[ 0.5 \]

\[ 0.75 \]

\[ 1 \]

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4. Interest control

![Graph showing different equilibria depending on the probability of bankruptcy.](image)

- $k$
- $\pi^*$
- $\pi_1$
- $\pi_2$
- $\pi_3$
- $\tilde{\pi}_0$

**Fig. 4:** Different equilibria depending on the probability of bankruptcy.
5. Conclusions

- Also if one allows for interest control as regulatory policy are there parameter constellations such that capital requirement is the best policy.
- This is due to the fact that interest control leads to a bloated banking sector which in turn is socially costly due to set-up costs of banks.
- It was possible to obtain this result by endogenizing the number of firms.