Economics of Banking
Lecture 20

May 2025

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Capital Regulation

- Stricter capital regulation may increase overall risk
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An oligopoly model with choice of correlation

Banks choosing deposits and loans (quantity-setting oligopoly)

Bank can choose ρ probability that the loan portfolio is perfectly uncorrelated (with probability $1-\rho$ it is perfectly correlated). Uncorrelatedness is obtained when there are many independent engagements (law of large numbers).

Cost $c(\rho_j)$ has its at "normal" level ρ_0.

Bank j chooses ρ_j loans L_j, deposits D_j *and* equity E_j to maximize

$$\Pi_j = p(s) r_L\left(\overline{L}\right) L_j - \left[\rho_j + (1-\rho_j) p(s)\right]\left(r_D\left(\overline{D}\right) + \alpha\right) D_j - r_E E_j - c(\rho_j) L_j.$$

with $\overline{L} = \sum_{i=1}^{N} L_i$, $\overline{D} = \sum_{i=1}^{N} D_i$.

With capital regulation

First order conditions wrt. ρ_j are:

$$c'(\rho_j)L_j = -(1-p(s))\left(r_D\left(\overline{D}\right)+\alpha\right)D_j. \tag{1}$$

Insert $E_j = kL_j$, $D_j = (1-k)L_j$ and write profits as

$$L_j\Big[p(s)r_L\left(\overline{L}\right) - (1-k)\left(\rho_j + (1-\rho_j)p(s)\right) \left(r_D\left((1-k)\overline{L}\right)+\alpha\right) - kr_E - c(\rho_j)\Big]$$

under the constraints given by $s + \dfrac{p(s)}{p'(s)} = r_L$.

How is this affected by k?

Rewrite (1) as

$$c'(\rho)L = (1-k)\left[r_D\left((1-k)\overline{L}\right)+\alpha\right]\left[p\left(s\left(\overline{L}\right)\right)-1\right],$$

determines ρ as implicit function of k.

Use notation $\Phi = \left[r_D\left((1-k)\overline{L}\right)+\alpha\right]\left[1-p\left(s\left(\overline{L}\right)\right)\right]$ to get

$$\frac{d\rho}{dk} = -\frac{1}{c''(\rho)}\left[-\Phi + (1-k)\left(\frac{\partial\Phi}{\partial\overline{L}}\frac{\partial\overline{L}}{\partial k}+\frac{\partial\Phi}{\partial k}\right)\right].$$

Here $c''(\rho) > 0$ if $c(\cdot)$ is a convex function, so $k\uparrow \Rightarrow \rho\uparrow$ if $[\cdot]$ negativ, that is if

$$(1-k)\left(\frac{\partial\Phi}{\partial\overline{L}}\frac{\partial\overline{L}}{\partial k}+\frac{\partial\Phi}{\partial k}\right) < \Phi$$

What does this tell us?

Higher capital ratio may lead to higher loan rates and imore risky investment, giving more correlation.

But standard effects of increased capital ratios are also at work:

Larger proportion of equity reduces the deposit rate, increasing interest margin, giving lower ρ.

The total effect is ambiguous and will depend on the parameter values.

But *it is possible that increased capital ratios may lead to higher correlation of bank portfolios.*

Overview of Basel

- **Basel I** (1988) Credit risk, capital regulation, risk-weighted assets, fixed percentages.
  Amendment: Market risk
- **Basel II** (2004) Internal ratings based approaches, Operational risk
- **Basel III** (2010) Liquidity, solvency, add-ons to capital ratios (SIFI rules)
- **Basel IV** (2017) Limits to use of internal methods

CoCo Bonds

Capital regulation shall guarantee that banks can pay back their debts.

Could we design a method so that funds for this purpose is forthcoming whenever needed?

First attempt: **Co**ntingent **Co**nvertible bonds: Debt which changes to equity upon a given condition.

CoCo bonds counts as part of equity according to Basel

Equity Recourse Notes

Assets to be used by bank creditors in case of default should be:

- assets posted as collateral,
- equity,
- unsecured debt which can be converted to equity.

The *debt* of a bank is then either

- deposits, backed by government securities,
- unsecured debt fully financed by the *equity recourse notes.*

Pricing of ERNs

Bank with equity and N of issues of ERNs:

In the kth issue of ERNs, value off bonds D_k, and by the rules to be converted to S_k shares. So price at conversion is D_k/S_k.

Issues are numbered so that

$$\frac{D_1}{S_1} > \cdots > \frac{D_k}{S_k} > \frac{D_{k+1}}{S_{k+1}} > \cdots > \frac{D_N}{S_N}.$$

(issue 1 is the first to be converted, then issue 2 etc).

S_0 number of original shares of the bank.

V value of the bank and $V_k(V)$ the market value of the bonds from the kth issue given V.

Determining when to convert I

Bank converts debt to shares when it increases the value of its shares, so conversion is made so as to maximize

$$\frac{1}{\sum_{i=0}^{j} S_i}\left(V - \sum_{i=j+1}^{N} D_i\right)$$

over $j = 1, \ldots, N$.

Value to the owners of the kth security is

$$V_k(V) = \min\left\{D_k, \max_j\left\{\frac{S_k}{\sum_{i=0}^{j} S_i}\left(V - \sum_{i=j+1}^{N} D_i\right)\right\}\right\},$$

(receive D_k or their bonds have been converted to S_k shares).

Determining when to convert II

This can be used to find X_k, by the condition

$$\frac{D_k}{S_k} = \frac{1}{\sum_{i=0}^{k} S_i} \left(X_k - \sum_{i=k+1}^{N} D_i \right),$$

from which we get that

$$X_k = \frac{D_k}{S_k} \sum_{i=0}^{k} S_i + \sum_{i=k+1}^{N} D_i.$$

Now the value of the bonds of issue k, given V, is

$$V_k(V) = S_k \left[\frac{V}{\sum_{i=0}^{N} S_i} + \sum_{j=k+1}^{N} \frac{S_j}{\sum_{i=0}^{j} S_i} \frac{E(V, X_j)}{\sum_{i=0}^{j-1} S_i} - \frac{E(V, X_k)}{\sum_{i=0}^{k} S_i} \right].$$

Advantages of the system

The main points:

- ERN bonds have a fairly transparent valuation, so that market prices will reflect their value,
- conversion to equity is a build-in feature – no liquidity crises

Bank will need no capital requirements – always enough equity.

Losses may occur but they are covered by shareholders (or bondholders converted to shareholders).