Economics of Banking
Lecture 19

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Capital Regulation (final comments)

- Stricter capital regulation may not increase capital.
- Capital regulation without regulators?

The Hyun-Rhee model

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

Entrepreneur sets up firm at $t = 0$. Needs C_0 borrowed from bank, repaid at $t = 2$.

Effort if entrepreneur e is uniform in $[0, 1]$

Production at $t = 1$ and $t = 2$, working capital C_t, gives

$$y_t(e) = \begin{cases} y & \text{with probability } p(e), \\ 0 & \text{with probability } 1 - p(e), \end{cases}$$

where $p(e) = eA + (1 - A)$

Independence: Same probability of defaulting at $t = 1$ and $t = 2$.

The Bank

Bank has capital $K > 0$ at $t = 0$. Cost of establishing the bank is K.

If capital requirements increase, bank must sell shares to the public.

Bank obtains deposits 1, assets are loans to enterprises or government bonds.

Deposit interest rate is r_D and the loan rate is r_L.

Government offers bonds and determines capital ratio, government bonds have weight 0 and loans have weight 1.

Economic activity

Firms maximize profits: If output y is at $t = 1$, profit is

$$\pi_1 = y - (r_L C_0 + (1 + r_L) C_1)$$

assumed to be consumed by the entrepreneur.

If outcome is 0, the firm waits for next period (bank accepts loss) possibly with a new owner.

At $t = 2$, the firm sells the factory at value C_0 and pays interest on the loan of C_0.

Bank observes e for each entrepreneur and find credit rating for the firm.

Bank behavior

At $t = 0$, all firms apply, remaining amount $1 + K - C_0$ in bonds.

At $t = 1$, expected period 1 profits from a loan t with credit rating e is

$$p(e)r_L(C_0 + C_1) - (1 - p(e))C_1,$$

and bank offers loans to all firms with $e \geq e_1$, where

$$p(e_1)r_L(C_0 + C_1) - (1 - p(e_1))C_1 = r_G C_1.$$

Assuming that depositors may invest in bonds, we have that $r_D = r_G = 0$, and the break-even condition is

$$p(e_1)r_L(C_0 + C_1) - (1 - p(e_1))C_1 = 0.$$

Bank profit I

Expected profit of the bank at $t = 1$:

Integrate over all firms (s, e) with rating $e \geq e_1$, for which the proportion of successful firms equals $eA + (1 - A)$, and then over all such e.

Successful firms found as all (s, e) with $e \geq e_1$ and $s \leq eA + 1 - A$, i.e.

$$(1-e_1)(Ae_1+1-A)+\frac{1}{2}(1-e_1)(1-(Ae_1+1-A)) = (1-e_1)\left(\frac{2-(1-e_1)A}{2}\right),$$

fraction of unsuccessful firms is

$$\frac{1}{2}(1-e_1)(1-(Ae_1+1-A)) = \frac{A}{2}(1-e_1)^2.$$

Bank profit II

Expected profit is

$$\pi(e_1) = (1 - e_1)\left(\frac{2 - (1 - e_1)A}{2}\right) r_L(C_0 + C_1) - \frac{A}{2}(1 - e_1)^2 C_1.$$

Let k be the capital ratio, then fraction of entrepreneurs that can obtain credits is restricted by $e \geq e_2$, where

$$\frac{K}{C_0 + (1 - e_2)C_1} = k.$$

Here e_2 may be greater or smaller than e_1, we assume that $e_1 \leq e_2$.

The bank offers credits to firms with $e \geq e_2$ and uses the remainder, $1 - K - C_0 - (1 - e_2)C_1$, on government bonds.

Bank profit III

Profits are as above

$$\pi(e_2) = (1 - e_2)\left(\frac{2 - (1 - e_2)A}{2}\right) r_L(C_0 + C_1) - \frac{A}{2}(1 - e_2)^2 C_1.$$

In $t = 2$, everything is repeated, bank offers credits on the same conditions as at $t = 1$.

At the end of period 2, long term loans C_0 are repaid.

Change in capital ratio

Assume that capital ratio is changed from k to $k' > k$.

If K is unchanged, e_2 must increase, and we get that

$$\frac{de_2}{dk'} = \frac{K}{C_1(k')^2}.$$

Differentiate to get that

$$\frac{d\pi(e_2)}{dk'} = \left[((1-e_2)A - 1)\, r_L(C_0 + C_1) + A(1-e_2)C_1\right] \frac{K}{C_1(k')^2}. \qquad (1)$$

On the other hand, if capital is extended profit may be unchanged but:

Changing capital

Existing shareholders get only $\nu = \frac{k}{k'}$ of profits, so profits change by

$$\pi(e_2)\frac{d\nu}{dk'} = \left[(1-e_2)\left(\frac{2-(1-e_2)A}{2}\right) r_L(C_0+C_1) - \frac{A}{2}(1-e_2)^2 C_1\right] \times \left(-\frac{k}{(k')^2}\right).$$

If C_0 is small, then $k \sim \frac{K}{(1-e_2)C_1}$, and

$$\pi(e_2)\frac{d\nu}{dk'} \sim \left[\left(\frac{2-(1-e_2)A}{2}\right) r_L(C_0+C_1) - \frac{A}{2}(1-e_2)C_1\right]\left(-\frac{K}{C_1(k')^2}\right).$$

Conclusion

Compare this expression with (1):

For small C_0, profits of eixsting shareholders are reduced less by cutting back loans than by issuing new shares.

We have thus shown:

It is a rational decision for the banks' shareholders to tighten credit as a response to increase in the capital ratio.

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).