Liquidity and Crises in Financial Markets

Funding Risk II

U of Basel, HS 2012

Main Idea

"... as long as the music is playing, you have to get up and dance."

Dynamic relationship between the financial industry's choices and interventions in financial markets.

Through their risk and leverage choices, banks force policy makers into action to relieve funding stress.

Whenever policy makers cannot commit to future policy actions, they are then held hostage by banks initial choices.

The way to react is by ex-ante regulation:

- liquidity ratios
- leverage

What's new here is that it is not an individual bank's actions, but the entire sector's actions.

This gives a rationale for "macro-prudential" supervision.

Situation might change if some banks keep extra liquidity to "feed off" distressed banks. We will look at this later.

Fahri and Tirole (2012)

Banks have projects:

- own capital A
- decide on project scale i
- issue (state-contingent) short-term debt, payable at $t = 1$

Project pay-offs have two components:

- $t = 1$: safe pay-off πi
- with prob. α: also $\rho_1 i$ at $t = 1$
- with prob. $1 - \alpha$: payoff $\rho_1 j$ only at $t = 2$ if j refinanced

Everyone is risk neutral. Shocks are correlated

Assume: $\alpha + \pi < 1$.

Maturity Mismatch

Problem: With probability $1-\alpha$, all banks need to pay back debt without having full pay-off.

Hence, need to refinance j projects at date $t=1$.

Limits on debt issue:

- can only pledge $\rho_0 i < \rho_1 i$ in "good" state
- can only pledge $\rho_0 j < \rho_1 j$ in "bad" state when refinancing

It is optimal to have the following state-contingent debt issue:

- in "good" state, pay $(\pi + \rho_0)i$ to debt holders
- in "bad" state, pay only di to debt-holders

Refinancing Decision

How can a bank refinance in the bad state?

- It has own cash holdings, $xi = (\pi - d)i$.
- It borrows against future income $\rho_1 j$ given interest rate R.

Hence, we get that the new scale of the bank in the "bad" state is

$$j = xi + \frac{\rho_0}{R} j \leq i$$

Interest rate is set exogenously by a central bank. It is normalized to 1 in the "good" state and is $R \leq 1$ in the "bad" state.

Initial Balance Sheet

Outside option for debt is normalized to 1.

The bank borrows up to

$$i - A = \alpha(\pi i + \rho_0 i) + (1-\alpha)di$$

This pins down leverage equal to

$$\frac{A}{i} = 1 - \pi - \alpha\rho_0 + (1-\alpha)x$$

Bank chooses its liquidity x to maximize

$$\max_{x\in[0,1-\rho_0/R]} (\rho_1 - \rho_0)(\alpha i(x) + (1-\alpha)j(x))$$

The objective function is hyperbolic in x

$$(\rho_1 - \rho_0)\left(\frac{\alpha + (1-\alpha)\frac{x}{1-\frac{\rho}{R}}}{1 - \pi - \alpha\rho_0 + (1-\alpha)x}\right)A$$

Hence: increasing x makes refinancing easier, but decreases leverage.

Result (Corner Solution):

Set $x = 1 - \frac{\rho_0}{R}$ as long as

$$\alpha + \pi < 1 + \alpha\rho_0\left(\frac{1}{R} - 1\right)$$

which is the case for any $R \leq 1$, since $\alpha + \pi < 1$.

In other words, *given* R there is no incentive to load-up on short-term debt.

Welfare Function

There are two welfare costs from setting interest rates $R < 1$:

- deadweight cost $L(R)$
- indirect subsidy from lenders to borrowers

Let $L(R)$ be decreasing on $[\rho_0, 1]$ and normalize $L(1) = L'(1) = 0$.

Lenders have s resources and need to be forced to fund $\rho_0 j$ at rate $R < 1$ for a total return of

$$\left(s - \frac{\rho_0 j}{R}\right) \cdot 1 + \rho_0 j = s - (1 - R)\frac{\rho_0 j}{R}$$

Possible implementation:

- tax storage at rate $1 - R$ and rebate it to lenders lump-sum
- both, return on storage and refinanced projects is R
- total return given by $Rs + (s - \frac{\rho_0 j}{R})(1 - R)$

Only in crisis times are there losses for lenders.

Suppose j projects are refinanced. Then total losses for lenders are given by

$$V(R) = -L(R) - (1-R)\frac{\rho_0 j}{R}$$

We also assume that total welfare is increasing in the number of projects financed.

$$W = V + \beta j$$

Assumption:

$$(1-\rho_0) \leq \beta \leq 1 - (\alpha + \pi) + (1 - \rho_0)$$

Optimal Policy with Commitment

Suppose the government can set a policy *ex ante* and commit to it.

View this as a benchmark.

No crisis: Set $R = 1$ since there is no refinancing need.

Crisis: Set $R \leq 1$ according to

$$W_0(R) = \alpha\left(V(1) + \beta i(R)\right) + (1-\alpha)\left(V(R) + \beta j(R)\right)$$

Since all projects get refinanced, we have that

$$i(R) = j(R) = \frac{A}{1 - \pi - \alpha\rho_0 + (1-\alpha)\left(1 - \frac{\rho_0}{R}\right)}$$

Given the assumption above, it follows immediately that $R = 1$ maximizes welfare.

No Commitment

Idea: central bank cannot decide (credibly) on an interest rate R ex-post.

No refinancing needs: central bank sets $R = 1$.

Refinancing needs: central bank will set R according to x.

Banks force a particular interest rate R^* ex-post through their choice of x. In other words, the choice of x is a strategic complement and the banks coordinate on it.

We will assume that

$$\frac{((\beta - (1 - \rho_0))A}{1 - \pi - \alpha\rho_0} = L(\rho_0)$$

and show that both, $R^* = 1$ and $R^* = \rho_0$ are an equilibrium.

Suppose banks expect R^*.

Then they set

$$x^* = 1 - \frac{\rho_0}{R^*}$$

and $i(R^*)$ accordingly.

There is no incentive to set $R < R^*$ for central bank ex post.

Why?

- all projects get refinanced anyway at R^*
- there are more social costs at R

Hence: $R = 1$ is an equilibrium.

There could be incentives to deviate and set higher interest rates $R > R^*$ to reduce deadweight losses.

Then, banks need to downsize to

$$j = \frac{x(R^*)}{1 - \frac{\rho_0}{R}} i(R^*) = \frac{1 - \frac{\rho_0}{R^*}}{1 - \frac{\rho_0}{R}} i(R^*) < i(R^*)$$

$R^* = \rho_0$ is also an equilibrium if and only if for all $R \in (\rho_0, 1]$ we get lower social welfare. This is the case if and only if

$$\frac{(\beta - (1 - \rho_0))A}{1 - \pi - \alpha\rho_0} \geq L(\rho_0)$$

<u>Intuition:</u>

Simply compare the loss in scaling down projects at $R > R^* = \rho_0$ with the reduction in the loss function for all $R > R^*$.

Result: Banks choose $x = 0$ and expensive bailout ($R = \rho_0$, $j = i_{\max}$) is also an equilibrium.

Correlated Risk Taking

Banks spread there risk across states $\theta \in [0,1]$ with measure α_θ such that

$$\alpha \geq \int \alpha(\theta) d\theta$$

The problem for each θ is just as before.

Why would they correlate their risks and choose all the same states with $\alpha(\theta) = 0$?

- max profit state by state taking the function $R(\theta)$ as given
- lower $R(\theta)$ will happen when more banks are distressed
- hence pay-offs are higher when $R(\theta)$ is low
- banks bunch on certain states and hence correlate risks

As a consequence, aggregate shocks arise endogenously.

Ex-ante Regulation

Consider a liquidity requirement so that $x \geq 1 - \rho_0$.

If refinancing is necessary at $t = 1$, there is no benefit anymore of setting $R < 1$.

Why? For all $\rho_0 < R < 1$, we get

$$\frac{x}{1 - \frac{\rho_0}{R}} \geq \frac{1 - \rho_0}{1 - \frac{\rho_0}{R}} > 1$$

so that $j(R) = i(R)$.

But lowering R has a social welfare cost.

Note: this would be here equivalent to a leverage regulation.

Transfers vs. Interest Rates

New scenario:

- not all banks are distressed
- central bank can imperfectly detect the distressed banks

Transfer directly increase the liquidity position of a bank.

If the transfer goes to the wrong banks, it is complete waste.

For interest rate policy, investors still get some return R back on their loans and there is less waste as only distressed banks profit from it.

Hence: interest rate policy is preferred, with transfers potentially lowering its extent.