Comments by Rafael Repullo on

Risk-taking and Joint Liquidity and Capital Regulation

Demian Macedo and Sergio Vicente

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Purpose of paper

- Moral hazard model of a single bank

  → Bank chooses capital, liquidity, and risk

  → Choice of risk is not observed by regulator

  → Depends on capital and liquidity

- Social welfare maximizer regulator

  → Can set minimum capital and liquidity requirements

  → Characterize second-best optimal requirements

Setup

- Limited liability bank chooses capital, liquidity, and risk at $t = 0$
  - → Subject to capital and liquidity requirements
  - → Insured deposits
  - → Costly capital (more than deposits)
  - → Costly liquidity (lower return than risky asset)
- Stochastic deposits withdrawals at $t = 1$
  - → Bank is closed if liquidity does not cover withdrawals

Main results

- Capital and liquidity requirements should be set jointly

    → Unlike in the silo approach of Basel III

- Optimal capital and liquidity requirements depend on

    → Cost of capital and opportunity cost of liquidity

    → Unlike in the statistical/quantitative approach of Basel III

- Differences between capital and liquidity requirements

    → Capital requirements always ameliorate risk-taking

    → Liquidity requirements may or may not do so

Main comments

- Paper is too long and unnecessarily convoluted

  → Sequential approach to solving maximization problem

  → Why not do it simultaneously?

- Paper considers exogenous deposit withdrawals

  → Appropriate given deposit insurance

  → But not if (part of) the bank's funding is uninsured

- Lender of last resort (LoLR) should be at the core of the paper

  → Do we need liquidity requirements when there is a LoLR?

What am I going to do?

- Consider a simple version of the model

- Derive three sets of results

  → No regulation (laissez faire)

  → Optimal regulation without moral hazard

  → Optimal regulation with moral hazard

- Briefly comment on related work on joint regulation

  → Rochet and Vives (2004) and König (2015)

Part 1

A simple version of the model

Model setup

- Three dates (t = 0, 1,2)
- Balance sheet of the bank at $t = 0$

Liquidity	$\rightarrow l$	d	$\leftarrow$	Demand deposits
Risky asset	$\rightarrow 1-l$	b	$\leftarrow$	Other deposits
		k	$\leftarrow$	Capital

Bank's liabilities

- Fixed demand deposits d
  - $\rightarrow$ Interest rate normalized to zero
  - $\rightarrow$ Amount β withdrawn at $t = 1$
  - $\rightarrow$ Assume uniform distribution in $[0,d]$
- Variable other deposits b
  - $\rightarrow$ Interest rate assumed to be zero
- Variable capital k (such that $k + b = 1 - d$)
  - $\rightarrow$ Cost of capital $\rho > 0$

Bank's assets

- Safe asset (liquidity)

  → Interest rate assumed to be zero

- Risky asset

$$\begin{tikzcd} 1 \arrow[rr] \arrow[dr] & & \begin{cases} M, & \text{with probability } \theta \\ 0, & \text{with probability } 1-\theta \end{cases} \\ & 0 & \end{tikzcd}$$

  → Success probability chosen by bank at $t = 0$ at a cost

$$c(\theta) = \frac{c}{2}\theta^2$$

Bank's objective function

- Two possible cases

  $\rightarrow$ If $\beta > l$ bank is closed and shareholders get zero

  $\rightarrow$ If $\beta \leq l$ bank is not closed and shareholders get

$$M(1-l)+(l-\beta)-(1-k-\beta)$$
$$= M(1-l)+l-(1-k), \text{ with prob. } \theta$$

- Bank expected payoff

$$\pi(k,l,\theta)=\left[M(1-l)+l-(1-k)\right]\theta F(l)-\frac{c}{2}\theta^2-(1+\rho)k$$

Laissez faire

- First-order conditions

$$\frac{\partial \pi}{\partial k} = \theta F(l) - (1+\rho) < 0 \quad \rightarrow \quad k^{LF} = 0$$

$$\frac{\partial \pi}{\partial l} = 0 \quad \rightarrow \quad l^{LF} = \frac{M-1+k}{2(M-1)} = \frac{1}{2}$$

$$\frac{\partial \pi}{\partial \theta} = 0 \quad \rightarrow \quad \theta^{LF} = \frac{[(M-1)(1-l)+k]F(l)}{c} = \frac{M-1}{4cd}$$

Social planner's objective function

- Social planner's expected payoff

$$\omega(k,l,\theta) = M(1-l)\theta F(l) + l - (1-k) - \frac{c}{2}\theta^2 - (1+\rho)k$$

- Two cases

  → First-best: Regulator chooses capital, liquidity, and risk

  → Second-best: Regulator chooses capital and liquidity +

  Bank chooses risk

First-best

- First-order conditions

$$\frac{\partial \omega}{\partial k} = -\rho < 0 \quad \rightarrow \quad k^{FB} = 0$$

$$\frac{\partial \omega}{\partial l} = 0 \quad \rightarrow \quad l^{FB} = \frac{1}{2} + \frac{d}{2M\theta}$$

$$\frac{\partial \omega}{\partial \theta} = 0 \quad \rightarrow \quad \theta^{FB} = \frac{M(1-l)l}{cd}$$

Comparison of first-best with laissez faire

- Numerical example: Let $M = 2$, $c = 2/3$, and $d = 3/4$

  $\rightarrow \ k^{LF} = k^{FB} = 0$

  $\rightarrow \ l^{LF} = 0.50 < 0.75 = l^{FB}$

  $\rightarrow \ \theta^{LF} = 0.50 < 0.75 = \theta^{FB}$

- First-best also has zero capital

  $\rightarrow$ Capital is costly and is not needed to provide incentives

- First-best has more liquidity and less risk than laissez faire

Second-best: bank’s choice of risk

- First-order condition

$$\frac{\partial \pi}{\partial \theta} = 0 \quad \rightarrow \quad \theta = \theta(k, l) = \frac{[(M-1)(1-l)+k]l}{cd}$$

- Notice that

$$\frac{\partial \theta}{\partial k} > 0$$

$\rightarrow$ Capital requirements always ameliorate risk-taking

$$\frac{\partial \theta}{\partial l} > 0 \text{ if and only if } l < \frac{M-1+k}{2(M-1)}$$

$\rightarrow$ Liquidity requirements when they are not too large

Second best

- Social planner's problem

$$\max_{k,l}\, \omega(k,l,\theta) \;\; \text{subject to} \;\; \theta = \theta(k,l)$$

$\rightarrow$ First-order conditions

$$\frac{\partial \omega}{\partial k} = -\rho + \left(\frac{M(1-l)l}{d} - c\theta \right) \frac{\partial \theta}{\partial k} = 0$$

$$\frac{\partial \omega}{\partial l} = \frac{M(1-2l)\theta}{d} + 1 + \left(\frac{M(1-l)l}{d} - c\theta \right) \frac{\partial \theta}{\partial l} = 0$$

$\rightarrow$ Be careful with corner solutions!

Comparison of second-best with laissez faire

- Numerical example: Let $M = 2$, $c = 2/3$, $d = 3/4$, and $\rho = 0.1$

  $\rightarrow$ $k^{LF} = 0 < 0.18 = k^{SB}$

  $\rightarrow$ $l^{LF} = 0.50 < 0.75 = l^{SB}$

  $\rightarrow$ $\theta^{LF} = 0.50 < 0.65 = \theta^{SB}$

- Second-best has positive level of capital

  $\rightarrow$ To ameliorate risk-taking incentives

- Second-best has more liquidity and less risk than laissez faire

Comments on extensions

- Possible liquidation of risky asset at $t = 1$ at fire sale discount

  → Interesting, but note that discount is exogenous

- Possible interbank market at $t = 1$

  → Interesting, but need to think about withdrawals

  → Are they driven by idiosyncratic or aggregate shocks?

- Possible information-based withdrawals

  → May need a completely different setup

Part 2

Related work on joint regulation

Introduction

- Change of focus

  → From retail deposits to (informed) wholesale investors

  → From stochastic withdrawals to information-based runs

- Change of modeling approach

  → Global games

Model setup (i)

- Three dates ($t = 0, 1, 2$)
- Continuum of risk-neutral investors

→ Invest D in the bank at $t = 0$

→ May withdraw DR_D at $t = 1$ or $t = 2$, with $R_D > 1$

→ Investor i observes signal $s_i = R + \varepsilon_i$

$R \sim N(\bar{R}, 1/\alpha)$ is return of bank's risky asset

$\varepsilon_i \sim N(0, 1/\beta)$ is an iid noise term independent of R

Model setup (ii)

- Balance sheet of the bank at $t = 0$

Risky assets $\rightarrow$	A	D	$\leftarrow$ Wholesale deposits
Reserves (cash) $\rightarrow$	$C = \phi D$	$K = \gamma A$	$\leftarrow$ Capital

where ϕ is a liquidity requirement and γ is a capital requirement

- By balance sheet identity we have

$$(1-\gamma)A = (1-\phi)D \;\rightarrow\; A = \frac{1-\phi}{1-\gamma} \quad (\text{normalizing } D = 1)$$

Deposit withdrawals

- Let x denote the proportion of deposits withdrawn at $t = 1$

- If $xR_D \leq \phi$ (withdrawals smaller than cash available)

  → Bank does not have to liquidate risky asset

  → In this case the bank fails if

$$RA + \underbrace{\left(\phi - xR_D\right)}_{\substack{\uparrow \\ \text{Cash remaining until } t\,=\,2}} < (1 - x)R_D$$

Liquidation costs

- If $xR_D > \phi$ (withdrawals greater than cash available)

  $\rightarrow$ Bank sells risky asset at price $R/(1+\lambda)$, with $\lambda > 0$

  $\rightarrow$ In this case the bank fails if

$$R\left[A - \underbrace{\frac{xR_D - \phi}{R/(1+\lambda)}}_{\substack{\uparrow \\ \text{Assets sold at } t=1}}\right] < (1-x)R_D$$

Bank failure

- Putting together the two previous conditions yields

$$R < \frac{1-\gamma}{1-\phi}\left[R_D - \phi + \lambda \max\left\{ xR_D - \phi, 0 \right\} \right] = R^*$$

where R^* is the bankruptcy point

Investors' withdrawal decisions (i)

- Let $p(s_i, x)$ denote probability of bank failure conditional on
  - $\rightarrow$ Signal s_i of investor i
  - $\rightarrow$ Withdrawal decisions of all other investors described by x
- Simple behavioral rule for investor i

$$\boxed{\text{Withdraw when } p(s_i, x) > \hat{p}}$$

  - $\rightarrow$ $\hat{p}$ is an exogenous parameter
  - $\rightarrow$ Could be rationalized in terms of delegation to managers

Investors' withdrawal decisions (ii)

- Clearly $p(s_i, x)$ should be decreasing in signal $s_i = R + \varepsilon_i$

  $\rightarrow$ Suppose that all investors follow a threshold strategy

$$\boxed{\text{Withdraw when } s_i < s^*}$$

- Threshold s^* is determined jointly with bankruptcy point R^*

Equilibrium

Proposition: When the precision β of the investors' signal is large, there is a unique equilibrium characterized by solution to

→ Investor's indifference condition

→ Bankruptcy point

Comparative statics

- Effect of capital requirements

  → An increase in γ always reduces R^*

  → Makes the bank safer

- Effect of liquidity requirements

  → An increase in ϕ reduces R^* when $R^* < 2(1-\gamma)$

  → Only when the bank is sufficiently safe

  → In the case of risky banks, they become riskier

Discussion

- Liquidity requirements as a double-edged sword (König, 2015)
- Two effects

  → *Liquidity effect*: larger buffer to withstand shocks

  → *Solvency effect*: lower asset returns

References

- König, P. (2015), “Liquidity Requirements: A Double-Edged Sword,” *International Journal of Central Banking*.
- Rochet, J.-C., and X. Vives (2004), “Coordination Failures and the Lender of Last Resort,” *Journal of the European Economic Association*.