How does macroprudential regulation change bank credit supply?[1]

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[1] Disclaimer: The views expressed are those of the authors and do not necessarily represent those of the Federal Reserve Board of Governors or anyone in the Federal Reserve System.

Motivation

- Propose a model where the banking sector has the following functions:
  1. Provides liquidity insurance
  2. Enhances sharing of aggregate risk
  3. Expands credit extension to the real economy
- Study the externalities emerging from intermediation and examine regulation to mitigate their effect
- We modify the classic Diamond-Dybvig model to address these issues

Our modifications to DD

1. Runs depend on fundamentals and are not just due to sunspots (or indeterminate)
2. Loans are made to fund a risky technology
3. The banks and the borrowers are subject to limited liability and markets are incomplete
4. Banks raise both deposits and equity

Consequences of these modifications:

- Runs create a risk that can result in under-investment
- Limited liability creates an incentive for excessive risk-taking

The Agents

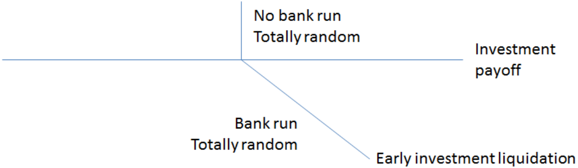
- A continuum of poor entrepreneurs (P) who owns the rights to a project but must borrow to implement it
- A continuum of rich savers (R) who can invest in a riskless asset, or make a bank deposit, or buy bank equity
  - Idiosyncratic liquidity shocks in intermediate period to consume early or late
  - Proportion of early consumers fixed, but shocks are private information and cannot be hedged
- A continuum of bankers (B) who has some trapped equity that can only by used for lending
  - B can also raise funds from R, to invest in P and the riskless asset

Basic Diamond-Dybvig

t=1
Riskless loan funded by deposits

t=2
Idiosyncratic preference shocks

t=3
Certain investment outcome

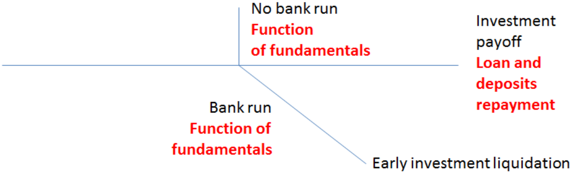


Our Framework

t=1
Risky investment funded by deposits & equity

t=2
Idiosyncratic preference shocks

t=3
Uncertain investment outcome



Externality from risk-taking

- Banks are tempted to gamble to exploit limited liability
- Depositors anticipate this and require an interest rate that accounts for the expected losses in bankruptcy
- If possible, they would rather write a contingent contract that ties the interest rate to the bank's risk-taking
- Hence, the private contract does not fully undo the limited liability distortion
- The planner accounts for these incentives and sets deposit rates accordingly

More

Externality from bank-runs

- Agents form rational expectations about the probability of a run, but take it as given
- In a global game they would get signals about the probability of a bad outcome to decide whether to run
- Goldstein-Pauzner work out an exact version:
  - For our setting running depends on debt/equity mix and amount of safe assets relative to risk assets
- We appeal to Goldstein-Pauzner and impose a particular functional form connecting the run probability to fundamentals:
  - Run is only possible if resources in the interim period are insufficient to repay everyone if they run. With insufficient resources, a run is more likely when leverage is higher or credit risk is higher
  - Probability of a run $q = f\,(\text{Capital ratio, Liquidity ratio, Liquidation value})$
- The planner accounts for this dependence

▸ Global Games

Table: Change in the probability of a bank-run: Constrained Planner vs. Competitive Equilibrium

		w^R							
		0.100	*0.200*	*0.300*	*0.400*	*0.500*	*0.600*	*0.700*	*0.800*
	0.100	-7.30%	-7.47%	-7.65%	-7.81%	-10.86%	-10.93%	-10.93%	-10.93%
	0.200	-6.81%	-6.97%	-7.14%	-10.84%	-10.92%	-10.93%	-10.93%	-
	0.300	-6.30%	-6.46%	-6.61%	-10.92%	-10.93%	-10.93%	-	-
w^P	*0.400*	-5.78%	-5.93%	-10.91%	-10.93%	-10.93%	-	-	-
	0.500	-5.25%	-10.91%	-10.93%	-10.93%	-	-	-	-
	0.600	-10.90%	-10.93%	-10.93%	-	-	-	-	-
	0.700	-10.93%	-10.93%	-	-	-	-	-	-
	0.800	-10.93%	-	-	-	-	-	-	-

1. Raise liquidity to control a run without preventing the bank from gambling (purple)
2. Raise bank equity to control a run and reduce investment to manage excess risk-taking (blue)
3. Raise bank equity to control a run and raise investment to help P or R (green)

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Capital regulation and dividend tax vs. capital and liquidity regulations

Table: Optimal Regulation for $w^P = 0.2$, $w^R = 0.6$, $w^B = 0.2$

	Competitive Equilibrium	Constrained Planner	Capital Regulation	Optimal Mix	Capital & Liquidity Regulation
I	2.548	2.536	2.782	2.536	2.435
q	0.109	0.000	0.000	0.000	0.000
CR	0.148	0.500	0.500	0.500	0.500
LR	0.213	0.125	0.125	0.125	0.295
τ_{Div}	-	-	-	0.439	0.000
τ_{LIQ}	-	-	-	0.487	0.000
U^P	-1.697	-1.663	-1.656	-1.663	-1.666
U^R	-0.206	-0.201	-0.201	-0.201	-0.200
U^B	-1.834	-1.805	-1.825	-1.805	-1.825
U^{sp}	-1.000	-0.979	-0.982	-0.979	-0.980

CR & LR: Alternative weights

Challenges of eliminating the run and limiting risk-taking

- Capital requirements can eliminate the run, but result in higher investment
- Deposit insurance eliminates the run, but it increases the incentives for risk-shifting
- A combination of capital requirements and dividend taxes can eliminate the run and tame risk taking, but it can violate the incentive compatibility constraint of patient depositors. Thus, it may also require a tax on liquid assets in order to yield the desired reduction in risk taking
- Capital and liquidity requirements together eliminate the run and reduce risk-taking, but also reduce the profits from intermediation and are harmful for the bankers
- Capital and loan-to-value requirements together can also eliminate the run and reduce risk-taking, but are harmful for the entrepreneur and reduce profits from intermediation

Conclusions

- Lots of insights from this approach, but must
  - use GE models, with forward looking agents, and allow banks to provide multiple services
- Regulations that reduce the risk of a run can potentially generate Pareto improvements
- Preventing the excessive gambling is harder because of counterbalancing effects on different agents
- Allocational consequences of different regulations creates incentives for regulatory arbitrage and to lobby

BACK-UP SLIDES

Externality from risk-taking

$$\sum_{s \notin s^D} (1-q) \cdot \omega_{3s} U^{B\,\prime}(c_{3s}^{B,no\text{-}run}) \left[V_{3s}^I (1+r^I) - \frac{1-\delta}{1-\delta(1+r_2^D)}(1+r_3^D) \right] = 0$$

- This equation implies that the banks takes on sufficient risk and leverage so that it makes losses in the medium risk state of the world
- This risk-shifting takes place because the banks ignore the consequences of its investment decision in the bankruptcy state $(V_{3b}^I(1+r^I) - (1+r^D))$
- But, *R* takes this into consideration and charges a higher deposit rate:

$$-\lambda_1^R + \lambda_2^{R,i,no\text{-}run}(1+r_2^D) + \lambda_2^{R,run,paid}(1+r_2^D) + \sum_s \lambda_{3s}^{R,p,no\text{-}run} V_{3s}^D (1+r_3^D) = 0$$

Back

- Assume that the probability of the state of the world, which is realized at $t = 3$, is driven by a state variable z_τ, $\tau \in \{1, 2\}$ and that $z_2 = z_1 + \eta$, where $\eta \sim U[-\bar{\eta}, \bar{\eta}]$
- We assume that η is realized at the beginning of period 2, but it is not publicly revealed. Rather, each depositor obtains a signal $x_i = \eta + \epsilon_i$, where ϵ_i are small error terms that are independently and uniformly distributed over $[-\epsilon, \epsilon]$
- While all impatient depositors demand early withdrawal, patient ones need to compare the expected payoffs from going to the bank in period 2 or 3. The ex-post payoff of a patient agent from these two options depends on both η and the proportion m of agents demanding early withdrawal
- We are interested in a threshold equilibrium in which a patient depositor with signal x_i withdraws his deposits at $t = 2$ when the signal is below a common threshold, i.e. $x_i \leq x^*$. Otherwise, he withdraws at $t = 3$. This implies also a threshold for the fundamental, i.e. a run will occur when $\eta \leq \eta^*$

$$\int_{m=\delta}^{\theta} \sum_s \omega_{3s} \left(z_1 + x^* + \epsilon \left(1 - 2\frac{m-\delta}{1-\delta} \right) \right) U^R(c_{3s}^{R,\text{no-run},\text{wait}})dm + \int_{m=\theta}^{1} \frac{\theta}{m} U^R(c_{3s}^{R,\text{run},\text{unpaid}})dm =$$

$$\int_{m=\delta}^{\theta} \sum_s \omega_{3s} \left(z_1 + x^* + \epsilon \left(1 - 2\frac{m-\delta}{1-\delta} \right) \right) U^R(c_{3s}^{R,\text{no-run},\text{withdraw}})dm + \int_{m=\theta}^{1} \frac{\theta}{m} U^R(c_{3s}^{R,\text{run},\text{paid}})dm$$

where $\theta = \frac{LIQ_1 + \xi \cdot I}{D^R(1+r_2^D)}$

▸ Return to bank-runs

Combining CR and LR for $w^P = w^R = 0.35$, $w^B = 0.3$

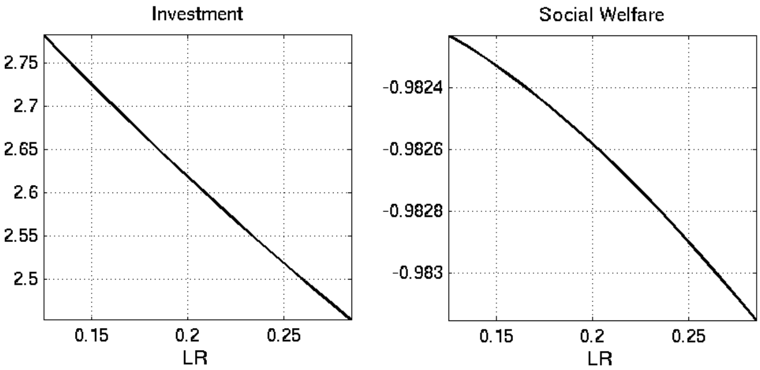

Figure: Risky investment (left) and social welfare (right) for stricter liquidity requirements under optimal capital regulation ($w^P = 0.35$, $w^R = 0.35$).

Return to optimal regulation