

# A Theory of Bank Liquidity Requirements

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The views expressed are solely those of the authors.

# History of Bank Liquidity Regulation

- **National Banking Era:** Macro-Prudential approach, uses cash reserves (interbank deposits) where ratio depends on position in the network.
- **Founding of Fed** continues this approach.
- **Reserve rations remain important in many countries** (Vegh), but were cut in U.S. after disintermediation of 70s in U.S., and capital ratios were instituted in 1981 (reserve interest would have avoided disintermediation).

# Bank regulation is changing

- Liquidity regulation prominent part of post-crisis regulation overhaul
- Basel Committee proposed two new standards (LCR and NSFR)

*"The objective of the LCR is to promote the short-term resilience of the liquidity risk profile of banks. It does this by ensuring that banks have an adequate stock of unencumbered high-quality liquid assets that can be converted easily and immediately in private markets into cash to meet their liquidity needs for a 30 calendar day liquidity stress scenario"*

# What is the economic rationale?

- LCR limits roll-over risk, penalizing short-term liabilities
- But:
  - isn't the creation of short-term liabilities what banks do?
  - don't we have interbank markets to deal with idiosyncratic liquidity shocks?
  - don't we have the lender-of-last resort to deal with dysfunctional interbank markets and aggregate shocks?
- Markets malfunctioned and central bank intervention has limits...why?
- Credit and counterparty risk

# The role of risk-taking

- Liquidity crises in banking almost always caused by increases in credit risk (Calomiris and Gorton, 1991)
- This crisis was no exception
  - Gorton and Metrick (2012), Covitz, Liang and Suarez (2013), Afonso, Kovner and Schoar (2011)
- Risk-management of banks important
  - importance of strong CROs (Ellul and Yerramilli, 2013)
  - banks with losses in 2008 = banks with losses in 1998 (Fahlenbrach, Prilmeier and Stulz, 2012)

# Cash as a prudential tool

- Focus on on the asset side of banks
- Constrain risk-taking by requiring them to hold reserves
  - like a margin call by counter-parties in derivative trading (Biais, Heider and Hoerova, 2010 )
- Properties of cash held at central bank
  - observable
  - not subject to moral hazard by bankers
  - opportunity cost of not investing in high-return (risky) assets
- Incentive role of cash *requires* liquidity risk
  - how to ensure that banks hold sufficient cash at the right time?
  - make senior outside claim withdrawable (expose banks to liquidity risk)
  - insurance against liquidity risk → cash must be regulated

## Capital as a prudential tool is problematic

- Usually equity (capital) is taken to controls credit risk
- But equity is assets minus liabilities
- Since assets are opaque and risky, so is equity
  - costly to issue (Myers and Majluf, 1984)
  - debt/deposits save on verification costs (Gale and Hellwig, 1985; Calomiris and Kahn, 1991)
  - deposits avoid hold-up problem by banker (Diamond and Rajan, 2001)
  - debt can be traded (Gorton and Pennacchi, 1990)
- Citibank had regulatory capital ratio of 11% when bailed out, Dexia had 12% on July 15, 2011, bail-out on 10th October

# Outline

1. Model
2. No moral-hazard (first-best): No cash
3. Moral-hazard: Cash as part of optimal contract
4. Deposit insurance, mutual liquidity insurance: Regulate cash

## 1. Model

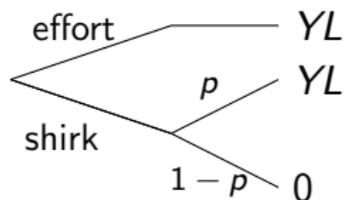
# Banking

- Risk-neutrality, no discounting, storage available
- Banker endowed with loan making ability
- Banker endowed with own (inside) equity  $E_0$
- Takes in deposits  $D$  and pays  $R$  to depositors
- Deposits are in elastic supply up to  $\bar{D}$
- Banker invests in risky loans  $L_0$  (return  $Y$  or  $0$ ) and safe cash  $C_0$
- Bank's balance sheet at  $t = 0$

$$C_0 + L_0 = D + E_0$$

# Moral-hazard in bank's risk-management

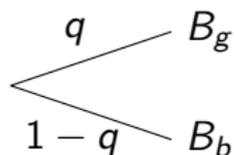
- Banker can exert unobservable risk-management effort



- Shirking carries private benefit  $BL$
- Protected by limited liability  $\rightarrow$  moral hazard
- With risk-management, loans are profitable  $Y > 1$

## Risk-management more difficult in some states

- Two aggregate states  $s$ , good or bad:  $s = g, b$ 
  - observable but not contractible



- Risk-management more difficult in bad state:  $B_b > B_g$
- Without risk-management in bad state, loan making is socially wasteful

$$1 > qY + (1 - q)(pY + B_b)$$

## Loans are illiquid

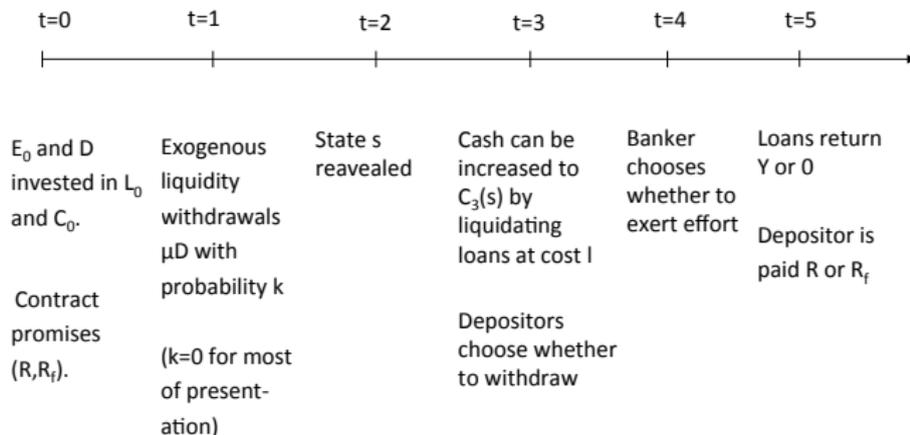
- After observing the aggregate state, banker can liquidate loans at a cost to increase cash holdings

$$\Delta C(s) = (1 - l)\Delta L(s)$$

- Increasing cash ex-post reduces the value of (inside) equity

$$E_2 = E_0 - \lambda \Delta C(s) \quad \text{where} \quad \lambda = \frac{l}{1 - l}$$

# Sequence of events

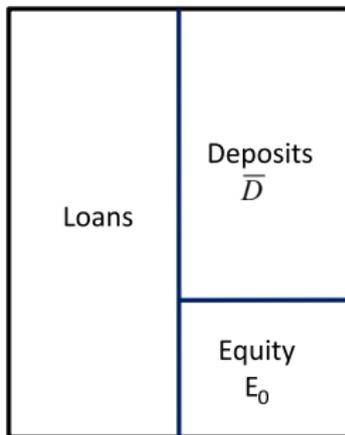


2. No moral-hazard

## Observable and contractible effort

- Effort is required since it is efficient
- Cash is not used since purely wasteful
- Depositors obtain:  $R = D$
- Banker's rent:  $(Y - 1)\bar{D} > 0$
- Bank does not offer right to withdraw

# First-best



### 3. Moral-hazard

## Incentive constraint (depends on state $s$ )

- Expected profit of banker under effort

$$YL_3(s) + C_3(s) - R$$

- Expected profit without effort

$$p [YL_3(s) + C_3(s) - R] + (1 - p)[C_3(s) - R_f] + B_s L_3(s)$$

- Incentive compatibility condition

$$\underbrace{\left( Y - \frac{B_s}{1 - p} \right)}_{\text{pledgeable return } P_s} L_3(s) + R_f \geq R$$

- It is optimal to pay all the cash in case of failure

$$R_f = C_3(s)$$

## Incentives to hold cash ex-ante and ex-post

- The incentive constraint can be written as

$$f_s E_0 + (1 - f_s \lambda) \Delta C(s) \geq D - C_0 \quad \text{where} \quad f_s = \frac{P_s}{1 - P_s}$$

- The banker's rent (i.e., in excess of  $Y E_0$ ) per unit of net return  $(Y - 1)$  is

$$(D - C_0) - (1 - q)(1 + r\lambda) \Delta C(b) \quad \text{where} \quad r = \frac{Y}{Y - 1}$$

- Assume no incentive problem in good state

# Aggregate state observable by depositors

outside financing capacity  $f_b = \frac{P_b}{1 - P_b}$



Loans	Equity $E_0$

<b>Loans liquidated bad state</b>	Deposits $\bar{D} - f_b E_0$
Loans	Deposits $f_b E_0$
	Equity $E_0$

	$\bar{D} - f_b E_0$
Loans	Deposits $f_b E_0$
	Equity $E_0$

## 4. Regulate cash

# Deposit insurance

- Deposit insurance scheme motivated by information externality
  - when bad state occurs a fraction  $\alpha$  of banker shirks on risk-management effort
  - deposit insurance optimal when depositors are risk averse
- When deposits are insured, depositor no longer impose higher liquidity via the threat of a run
- Banker shirks on risk-management in bad state and banking becomes socially wasteful
- Regulator imposes liquidity requirement despite no liquidity risk

# Mutual liquidity insurance

- We add exogenous liquidity risk
  - with probability  $k$  a bank experiences a withdrawal of  $\mu D$  deposits
  - the deposits finance purchases abroad  $\rightarrow$  leave the system
- A coalition of banks can diversify them (interbank market)  $\rightarrow$  only  $k\mu D$  needed (instead of  $\mu D$ )
- Liquidity insurance by coalition creates free-riding
  - a bank could borrow (claiming it had a withdrawal) instead of holding cash
- The coalition imposes liquidity requirements and sends transfers abroad on behalf of banks (clearing house)

# Implications for regulation

- Liquidity (reserves) as risk prevention (ex ante) rather than risk insurance (ex post)
  - resolves "Goodhart's Paradox" of liquidity regulation
- Need for reserve accounts
- Assets and liabilities are jointly determined
  - capital and liquidity regulation must be joint
- Deposit insurance, bail-outs or interbank markets all undermine control-right of depositors
  - stable deposits make matters worse, and yet lower LCR

## Concluding remarks

- Reserves as a prudential tool
- Benefits of reserves: observable, safe and liquid
- Reserves can improve risk-management incentives
- Threat of withdrawal "imposes" reserve holding
- Deposit insurance eliminates liquidity risk but also threat of withdrawal → regulate reserves
- Share liquidity risk in an interbank market allows to free-ride on others' reserves → regulate reserves