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
Liquidity crises in banking almost always caused by increases in credit risk (Calomiris and Gorton, 1991)

This crisis was no exception


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 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
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

\[
\begin{align*}
&\text{effort} \quad YL \\
&\text{shirk} \quad p \quad YL \\
&1-p \quad 0
\end{align*}
\]

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

\[ E_2 = E_0 - \lambda \Delta C(s) \text{ where } \lambda = \frac{l}{1 - l} \]
Sequence of events

$t=0$  
$E_0$ and $D$ invested in $L_0$ and $C_0$.  
Contract promises $(R,R_f)$.

$t=1$  
Exogenous liquidity withdrawals $\mu D$ with probability $k$  
($k=0$ for most of presentation)

$t=2$  
State $s$ revealed

$t=3$  
Cash can be increased to $C_3(s)$ by liquidating loans at cost $l$

$t=4$  
Banker chooses whether to exert effort

$t=5$  
Loans return $Y$ or $0$  
Depositor is paid $R$ or $R_f$
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: \( (Y - 1)\overline{D} > 0 \)
- 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
  \[ p \left[ YL_3(s) + C_3(s) - R \right] + (1 - p) \left[ C_3(s) - R_f \right] + B_s L_3(s) \]

- Incentive compatibility condition
  \[ \left( Y - \frac{B_s}{1 - p} \right) L_3(s) + R_f \geq R \]
  where $P_s$ is the pledgeable return.

- 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 YE₀) 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 \( f_b = \frac{P_b}{1 - P_b} \)
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