To sell or to borrow?

A Theory of Bank Liquidity Management

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The views expressed herein are those of the author and do not necessarily represent those of the Federal Reserve Bank of Kansas City or the Federal Reserve System.

Motivation

- Banks manage liquidity using tradable assets that bear credit risk (in addition to cash and interbank markets)

- Reliance on tradable assets induces a trade-off
  - Lower cost of liquidity management
  - Liquidity management directly exposed to credit risk shocks:
    - August 2007: stress on ABCP market⇒ stress on interbank markets⇒ liquidity hoarding and central banks' interventions

- **Goal of this paper:**
  - Understand this trade off
  - Positive and normative implications

Framework

- Theory of how banks cope with liquidity needs using internal **cash**, interbank **borrowing** and asset **sales**
  - A generic Diamond-Dybvig setup *without runs*
  - A model of an acute liquidity shock as in August 2007

- Funding of a liquidity need complicated by uncertainty about banks' risk
  - Banks' liquidity needs and risk are independent and idiosyncratic
  - No liquidity shortage on aggregate

Insights

1. Asymmetric information affects relative cost of liquidity between different markets
    1. Which of the markets freezes depends on which is more affected by asymmetric information
    2. Illustration why the U.S. interbank market did not freeze contrary to the Europe

2. Novel policy implications under solvency concerns:
    1. Interbank liquidity injections may be effective
    2. Asset purchases are not effective

Literature Review

Theory

1. Freixas, Martin and Skeie (2011)
2. Freixas and Holthausen (2005) and Heider, Hoerova and Holthausen (2009)
3. Malherbe (forthcoming) and Bolton, Santos and Scheinkman (2011)

Empirics

Nyborg and Ostberg (forthcoming)

Outline

1. Setup
2. Results
3. Policy implications
4. Empirical evidence
5. Conclusion

Setup

t=0:

- Continuum of mass 1 of identical banks
- Each bank invests $\lambda \in [0; 1]$ of its endowment in cash and $1 - \lambda$ in a risky asset

t=1:

- Each bank receives **two private** signals about **risk** of its asset and its **liquidity** need
- The interbank and secondary markets open
  - Liquid banks choose whether to sell and/or lend
  - Illiquid banks choose whether to use cash, borrow and/or sell
  - The only buyers are outside investors with deep pockets

t=2:

- The risky asset's returns are realized and payments are made

Private Signals

- Signal about risk of bank's asset

$$\begin{cases} R, \text{ with prob. } p_i \\ 0, \text{ otherwise} \end{cases} \quad \text{"}\textbf{Good}\text{"}: \; p_G = 1 \text{ with prob. } q, \text{"}\textbf{Bad}\text{"}: \; p_B = p < 1$$

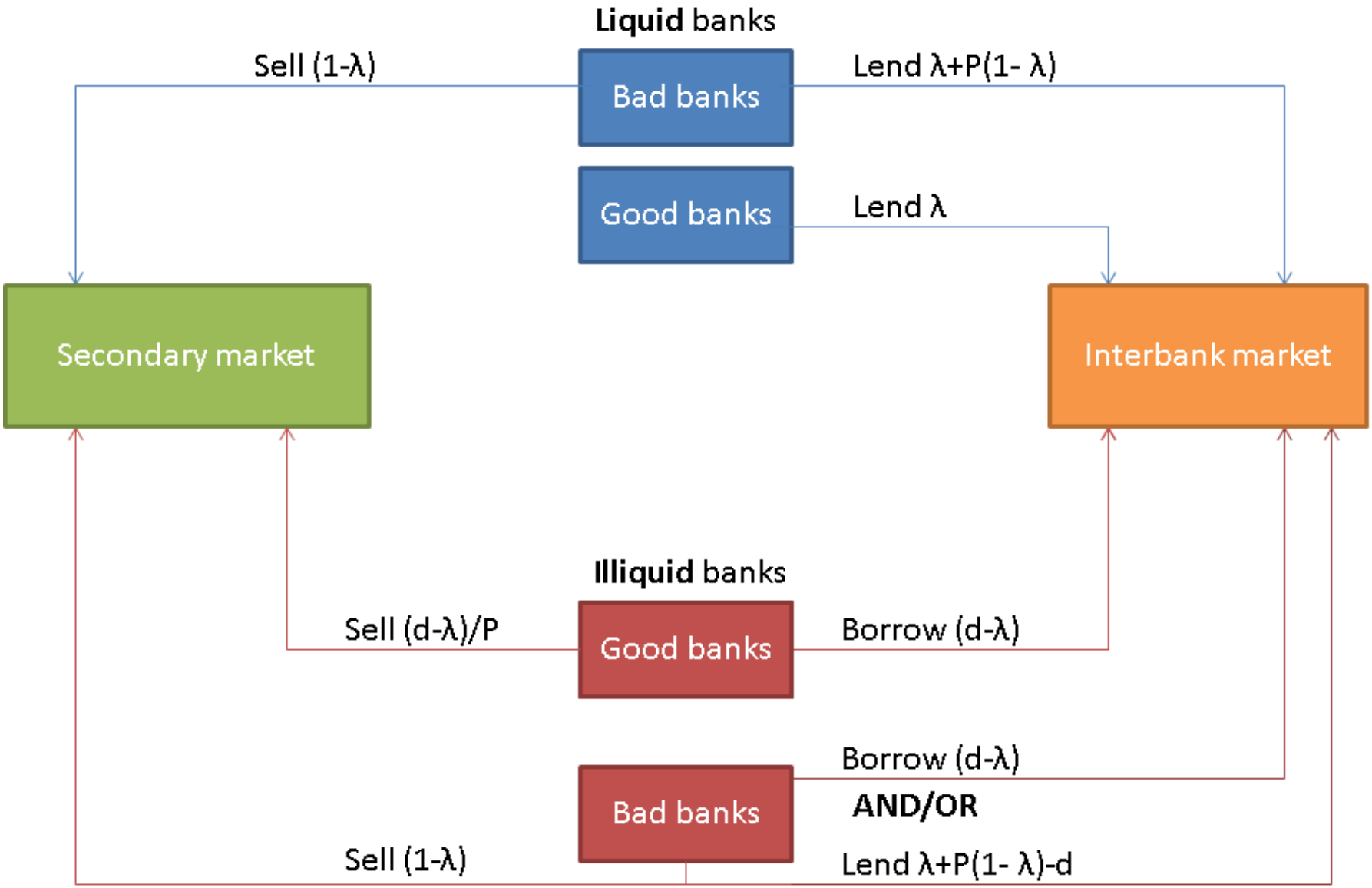
- Signal about liquidity
  - "**Illiquid** bank" suffers a refinancing shock with prob. $1 - \pi$ and needs to pay d to survive till $t = 2$

- Signals are independent

Interbank and Secondary Markets

- Interbank lending
  - Unsecured
  - Interbank loans are fully diversified
  - Anonymous

- Secondary market
  - The **only** buyers of bank assets are outside investors
  - Cash-in-the-market effect only on the interbank market


Liquid banks
Sell (1-λ)
Bad banks
Lend λ+P(1- λ)
Good banks
Lend λ
Secondary market
Interbank market
Illiquid banks
Sell (d-λ)/P
Good banks
Borrow (d-λ)
Borrow (d-λ)
Bad banks
AND/OR
Sell (1-λ)
Lend λ+P(1- λ)-d

Equilibrium at t=1 - Role of asymmetric information

- Adverse selection on both, secondary and interbank, markets
- For given asset price and loan rate
  - **Good banks less willing to sell than bad banks**
- Adverse selection is less costly for good banks when they borrow

Equilibrium at t=1 - To sell or to borrow?

- Trade-off for the bad illiquid banks:
  - Borrowing is attractive, because good banks borrow
  - Cost of borrowing depends on banks' cash reserves
- **Average riskiness of the selling banks is higher than of the borrowing**
- Adverse selection affects **selling** banks' ability to cover their liquidity shortfall
  - Good banks prefer to borrow depressing quality and price of the asset

Equilibrium at t=1 - Liquidity Transfer

- Adverse selection is not too severe (q is high)
  - All illiquid banks can cover their liquidity shortfall
- As cash reserves $\uparrow$, more of the riskier banks switch to interbank market
  - Price of the asset $\downarrow$
  - Loan rate and interbank lending volume $\uparrow$ first and then $\downarrow$

Equilibrium at t=1 - Liquidity Transfer

- Adverse selection is severe (q is low)$\Rightarrow$low price of the asset
  - Selling banks cannot become liquid
- Selling banks rush to the interbank market
  - Rationing of liquidity
  - Some banks default

Role of the interbank market

- Without interbank market, price of the asset is sufficiently high
  - Good banks have to sell increasing asset quality
- With interbank market, good banks borrow instead
  - Price of the asset falls and in turn interbank market suffers from illiquidity
- Mechanism through which adverse selection spreads from the secondary to the interbank market

Equilibrium at t=0 - Ex-ante choice of cash reserves

- Trade-off:
  - Cost: less of the long-term asset
  - Benefits: speculative and precautionary motive
- Cash reserves $\uparrow$ when the asset's return $\downarrow$
- Banks do not internalize their defaults

Policy Implications

- An additional shock:
  - no adverse selection ($q = 1$) with prob. $1 - \varepsilon$
  - adverse selection ($q < 1$) with prob. $\varepsilon > 0$
- For $q < 1$ the loan rate is higher and price of the asset is lower than for $q = 1$
- Reason for central bank's intervention?

Policy Implications

- If there are no defaults:
  - Elevated loan rate and depressed price reflect fundamentals and adverse selection
  - Any intervention is welfare-neutral
- If banks default:
  - An intervention is needed

Policy Implications

- Liquidity injections on the interbank market prevent defaults
  - "Unintended consequence": crowding out of private sources of liquidity
- Asset purchases are not effective:
  - Price decline due to adverse selection (even with fire sales)
- Ex ante liquidity requirements avoid defaults

Empirical Evidence - Previous Literature

- Acharya, Afonso and Kovner (2013):
  - Interbank borrowing increased after the collapse of the ABCP market in August 2007
- Kuo, Skeie, Youle, and Vickrey (2013):
  - Term interbank markets did not freeze
- Evidence on effectiveness of liquidity injections is mixed
  - Taylor and Williams (2009), Brunetti, di Filippo, and Harris (2011)
  - McAndrews, Sarkar, and Wang (2008)

Empirical Evidence - very preliminary

- Federal Reserve's data with a weekly frequency for commercial banks: Schedule H8/FR 2664
  - aggregated at the BHC level
- Schnabl's exposure data from Acharya, Schnabl and Suarez (2012)

Empirical Evidence - very preliminary

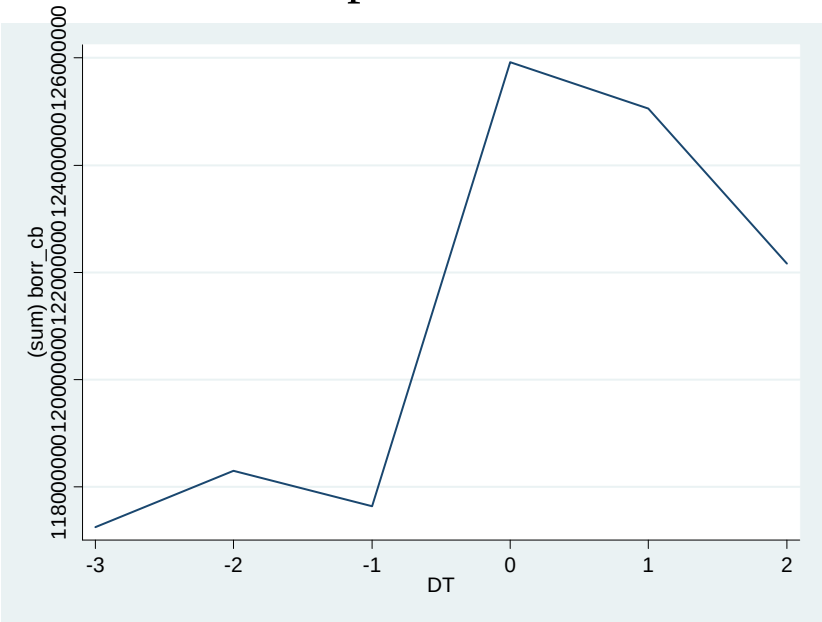
Change in interbank borrowing between Aug 8 and 15, 2007 for those with and without exposure

```
. sum ch

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
          ch |        792    6629.501    294227.3  -3446156    7429977

. sum ch if exposure==0

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
          ch |        776   -3906.063    125033.8  -3446156     293287

. sum ch if exposure>0

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
          ch |         16    517604.4     1863635   -344126    7429977
```

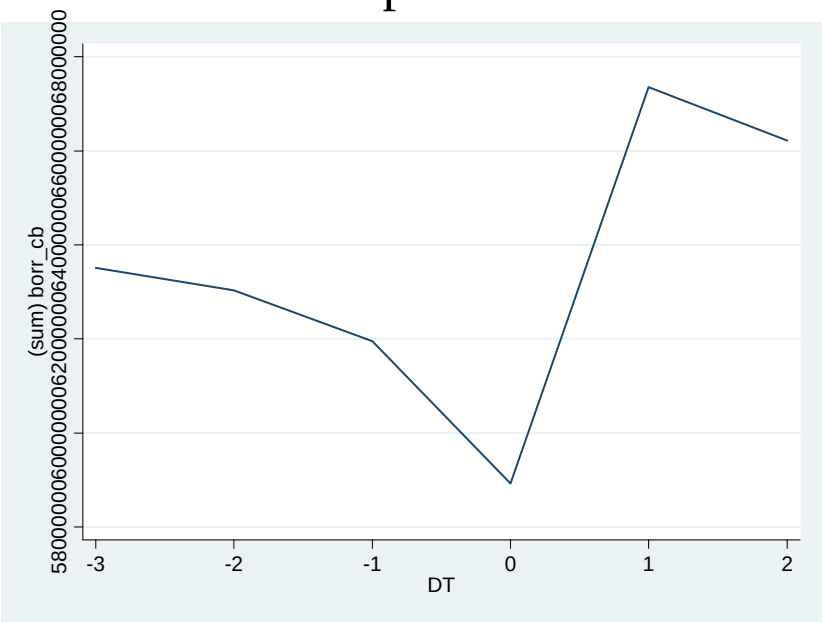
Empirical Evidence - very preliminary

t=0 is Wed, Aug 15, 2007

Those with exposure to ABCP



Those without exposure to ABCP



Europe vs. US

- Empirical and anecdotal evidence:
  - U.S.: no freeze on the interbank markets, freeze of secondary markets for subprime bonds
  - Europe: freeze of the interbank markets, but trade in sovereign debt

- Model: Important which of the markets is more affected by asymmetric information
  - U.S.: quality of subprime bonds unknown$\Rightarrow$both markets affected$\Rightarrow$but borrowing is less sensitive to information
  - Europe: unknown exposures to sovereign debt$\Rightarrow$interbank market froze, but trade in sovereign debt!

Conclusions

- Simple model of bank liquidity management with novel results
  - Fragility of reliance on tradable assets due to existence of interbank markets
  - Uncertainty about risk on the interbank market depends on cash reserves
  - Novel policy implications
  - Explanations of differing performance of interbank markets in the U.S. and in Europe