Self-fulfilling Fire-sales, Bank Runs and Contagion:
Implications for Bank Capital and Regulatory Transparency

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Introduction
- Motivation
- Endogenous Prices
- Twin Illiquidity
- Contagion
- Applications

Model Setup

Baseline Model

Applications of the Model

Conclusion

The Evolving Theories of Bank Runs

- Panic-based bank runs: multiple equilibria, sunspot bank runs
  - Diamond-Dybvig (1983)
- Fundamental-based bank runs:
  - Gorton (1988), Calomiris & Gorton (1991), Calomiris & Mason (2003).
  - Chari & Jagannathan (1988), Jacklin & Bhattacharya (1988), Allen & Gale (1998)
- Refinement by global games, bridging the two approaches
  - Unique equilibrium, cut-off fundamental, solvent but illiquid banks
  - Morris & Shin (2000), Rochet & Vives (2004), Goldstein & Pauzner (2005)
- Limitation: simplifying assumption of exogenous fire-sale price/losses
  - ignoring the reinforcing effects of bank runs on fire-sales
  - endogenous fire-sale prices allow more intricacies

Introduction
- Motivation
- Endogenous Prices
- Twin Illiquidity
- Contagion
- Applications

Model Setup

Baseline Model

Applications of the Model

Conclusion

Endogenous Asset Prices under Information Friction

- Endogenous fire-sale prices/losses
  - based on the micro-foundation of adverse selection
  - richer than approaches like cash-in-the-market
- Motivation: difficult to distinguish between insolvent and illiquid banks
  - the lack of information, especially in crisis times
  - illiquid banks, once forced to liquidate, indistinguishable from insolvent ones
- Runs on illiquidity banks $\Rightarrow$ pooled with the insolvent, adverse selection
- Distorting downwards asset prices, fueling runs in the first place

Introduction
- Motivation
- Endogenous Prices
- Twin Illiquidity
- Contagion
- Applications

Model Setup

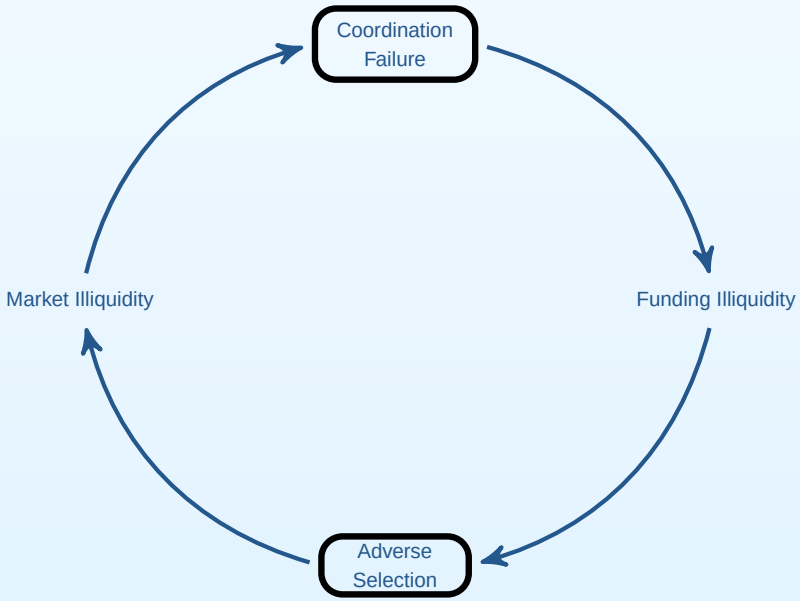
Baseline Model

Applications of the Model

Conclusion

Mutually Reinforcing & Self-fulfilling Runs and Fire-sales

- Two-way feedback between fire-sales and bank runs
  - fire-sale losses $\Rightarrow$ coordination failures and runs
  - runs $\Rightarrow$ illiquid banks pooled with the insolvent, resulting in fire-sale losses
  - mutually Reinforcing $+$ self-fulfilling
- A vicious liquidity spiral



Introduction
- Motivation
- Endogenous Prices
- Twin Illiquidity
- Contagion
- Applications

Model Setup

Baseline Model

Applications of the Model

Conclusion

A Natural Extension to Contagion

- Just one more ingredient: a common risk exposure
- Contagion via informational externalities
  - a bank run $\Longrightarrow$ pessimistic belief updating on common risk
  - reducing prices of all other banks' assets
  - runs self-fulfilling at other banks
- A structured framework, where
  - Buyers beliefs, asset prices, bank runs, and contagion, all endogenous
  - Equilibrium existent and unique
    - ranking banks: insolvet, illiquid, vulnerable to contagion
    - facilitating policy evaluation: how each of the risk reacts

Introduction
- Motivation
- Endogenous Prices
- Twin Illiquidity
- Contagion
- Applications

Model Setup

Baseline Model

Applications of the Model

Conclusion

Applications of the Framework

- Question 1
- Is capital requirement as effective as we thought?
  - (Conventional) 'Buffer Effect': setting off fire-sale losses, reducing illiquidity & contagion
  - (New) 'Inferencing Effect': unintended consequences under endogenous asset prices
  - A well capitalized bank unlikely to fail. But if it fails, very pessimistic beliefs...
    - individual bank returns unusually low $\Rightarrow$ low asset prices $\Rightarrow$ bank run
    - common risk unusually high $\Rightarrow$ low asset prices $\Rightarrow$ contagion
  - The two forces countervail each other
- Overall assessment: 'buffer effect' dominates
  - A reassuring result

Introduction
- Motivation
- Endogenous Prices
- Twin Illiquidity
- Contagion
- Applications

Model Setup

Baseline Model

Applications of the Model

Conclusion

Applications of the Framework (continued)

- Question 2
- Assuming commitment power, shall regulators commit to be transparent?
  - Distinguishing between insolvency and illiquidity
  - Equally hard for regulators
  - But, possible disclosure of the aggregate info. E.g.,
    - macroeconomic fundamentals
    - aggregate size of assistance programs
    - scenarios in stress testing
  - Commitment to transparency as a double-edged sword
    - if favorable, calming down the market, saving banks from illiquidity
    - if unfavorable, acknowledging a crisis, exacerbates illiquidity/contagion
- If the cost of systemic crisis sufficiently high $\Rightarrow$ suboptimal transparency

Introduction
Model Setup
- Banks
- Bank Runs
- Adverse Selection

Baseline Model
Applications of the Model
Conclusion

Model Setup

Introduction
Model Setup
- Banks
- Bank Runs
- Adverse Selection
Baseline Model
Applications of the Model
Conclusion

Setup

- Two-bank industry, banks ex ante identical
- Banks borrow short-term lend long-term
- Assets: long-term risky asset
  - $\theta \sim U(\underline{\theta}_s, \overline{\theta})$
  - two states $s = 1, 2$, $\underline{\theta}_1 < \underline{\theta}_2$
  - physical liquidation impossible
- Liabilities: unit investment solely financed by short-term debts
  - debt risky: $r_D > \underline{\theta}_s$
  - r_D at $t = 2$
  - qr_D at $t = 1$, penalty q arbitrarily close to 1

Introduction
Model Setup
- Banks
- Bank Runs
- Adverse Selection

Baseline Model
Applications of the Model
Conclusion

Creditors & Runs

- Uninsured short-term debts
- A continuum of creditors, 'run' at $t = 1$ or 'wait' till $t = 2$
- No common knowledge on θ
- Run upon privately observed noisy signals
  - $s_i = \theta + \epsilon_i$
  - ϵ_i drawn from a continuous distribution on $[-\sigma, \sigma]$
  - σ sufficiently small
- Simultaneous individual decision on runs
- Refinement by Global Games

Introduction
Model Setup
- Banks
- Bank Runs
- Adverse Selection

Baseline Model
Applications of the Model
Conclusion

Liquidation & Adverse Selection

- Financial liquidation upon a run
- Asset sold to uninformed buyers: cannot observe θ
- Observing the outcome of bank runs, $n \in \{0, 1, 2\}$
  - cannot distinguish the illiquid from the insolvent
  - updating beliefs on θ and s
- Break-even in competitive markets
- Time-line of the model

t = 0	t = 1	t = 2
Banks issue 1 unit of demandable debt.	1. Upon signals, creditors decide to run or not. 2. Observing bank runs, buyers offer price P.	Returns realize.

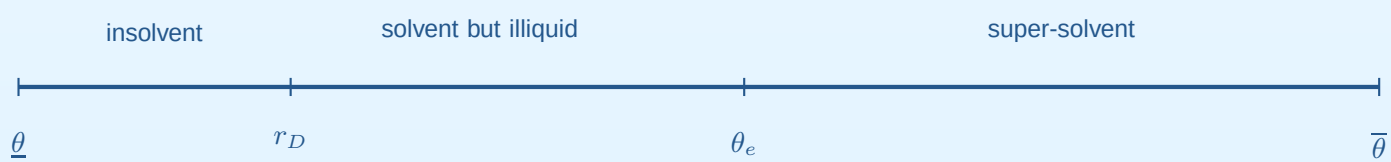
Introduction
Model Setup
Baseline Model
- Illustration
- Full Model
Applications of the Model
Conclusion

Baseline Model

Introduction
Model Setup
Baseline Model
- Illustration
- Full Model
Applications of the Model
Conclusion

Self-fulfilling runs: an Illustration

- Special case: one bank, one state $\underline{\theta}_1 = \underline{\theta}_2 = \underline{\theta}$
- No contagion, no inferencing, price reflecting only adverse selection
- Equilibrium characterized by $\{\theta_e, P_e\}$
- Global games equilibrium
  - for a given P, a critical θ for bank run $\hat{\theta}_P = \frac{r_D - P}{1-q}$
- P_e consistent with competitive equilibrium
  - zero-profit: $E(\theta|\theta < \hat{\theta}_P) - P = 0$
  - no profitable deviation: new payoff decreasing in P
- Equilibrium $P_e = \frac{r_D + (1-q)\underline{\theta}}{3-2q}, \quad \theta_e = \frac{r_D + (r_D - \underline{\theta})}{3-2q} > r_D$



Introduction
Model Setup
Baseline Model
- Illustration
- Full Model
Applications of the Model
Conclusion

Full-fledged Model

- Introducing different states $\theta_1 < \theta_2$
- Belief updates on s, conditional on the number of bank runs
- Critical cash flows
  - θ^*: run for $\theta < \theta^*$ *conditional on 1 run*
  - θ^{**}: run for $\theta < \theta^{**}$ *conditional on 2 run*
  - unique competitive equilibrium derived from break-even conditions
- $\theta^{**} > \theta^*$: more runs lead to unfavorable ex post belief on s
- A bank with $\theta \in (\theta^*, \theta^{**}]$ is exposed to contagion
  - surviving if $\theta > \theta^{**}$ for the other bank
  - failing otherwise

Introduction
Model Setup
Baseline Model
Applications of the Model
- Capital
- Disclosure Policy

Conclusion

Applications of the Model

Introduction
Model Setup
Baseline Model
Applications of the Model
- Capital
- Disclosure Policy
Conclusion

Capital - Illustration

- Buffer Effect of capital
  - price exogenous
  - $\partial(\hat{\theta} - r_D)/\partial r_D = q/(1-q) > 0$
- Inferencing Effect of capital: via endogenous asset prices
  - price endogenous $P = [r_D + (1-q)\underline{\theta}]/(3-2q)$
  - asset price drops with capital

    $$\partial P/\partial r_D = 1/(3-2q) > 0$$
  - pessimistic belief updating at work
  - capital less able to contain liquidity risk

    $$\partial IL/\partial r_D = (-1+2q)/(3-2q) < q/(1-q)$$
- Overall, buffer effect dominates, higher capital reduces illiquidity

Introduction
Model Setup
Baseline Model
Applications of the Model
- Capital
- Disclosure Policy
Conclusion

Capital - Extended

- Exposure to contagion: $Prob(\theta^* < \theta < \theta^{**})$
- Systemic risk - both banks fail: $Prob(\theta < \theta^{**})^2$
- Similar exercise using the full model
- Comparative statics for different types of risk
  - lower liquidity risk
  - higher exposure to contagion
  - lower systemic risk
- Overall, capital reduces financial fragility, but with more subtlety.

Introduction
Model Setup
Baseline Model
Applications of the Model
- Capital
- Disclosure Policy
Conclusion

Regulatory Transparency

- Information-based run and contagion: can disclosure policy help?
  - individual θ hard to discern
  - s can be revealed
- Baseline model extended
  - a regulator observes perfectly s
  - commitment to announce it before trade
  - prices contingent on s, no longer on n: P_B, P_G
  - info on s improves; adverse selection remains

t = 0	t = 0.5	t = 1	t = 2
Banks issue 1 unit of demandable debt.	1. State s realizes. 2. Regulator announces the realization	1. Upon signals, creditors decide to run or not. 2. Depending on announcement, buyers offer price P_B or P_G.	Returns realize.

Introduction
Model Setup
Baseline Model
Applications of the Model
- Capital
- Disclosure Policy
Conclusion

Regulatory Transparency

- Equilibrium critical levels θ_G^* and θ_B^*
  - $\theta_G^* = \frac{2r_D - \underline{\theta}_2}{3-2q}$
  - $\theta_B^* = \frac{2r_D - \underline{\theta}_1}{3-2q}$
- $\theta_G^* < \theta^*$ and $\theta_B^* > \theta^{**}$
- Policy trade-off
  - mitigating illiquidity if $s = 2$
  - exacerbating illiquidity if $s = 1$

- denote the cost of systemic crises, C_B and C_G
- $\exists$ critical $\hat{C}$, for $C_B/C_G > \hat{C}$, disclosure suboptimal

Introduction
Model Setup
Baseline Model
Applications of the Model
Conclusion

Conclusion

Introduction
Model Setup
Baseline Model
Applications of the Model
Conclusion

Concluding Remarks

- Self-fulfilling and mutually reinforcing bank runs and contagion
- Endogenous asset prices
- Subtler impact of capital
  - overall reducing financial fragility, but
  - unintended consequences on illiquidity and contagion
- Disclosure policy should be macro-prudential
  - info on individual banks: useful but hard to obtain
  - aggregate states: disclosure with caution