Information Acquisition in Rumor-Based Bank Runs

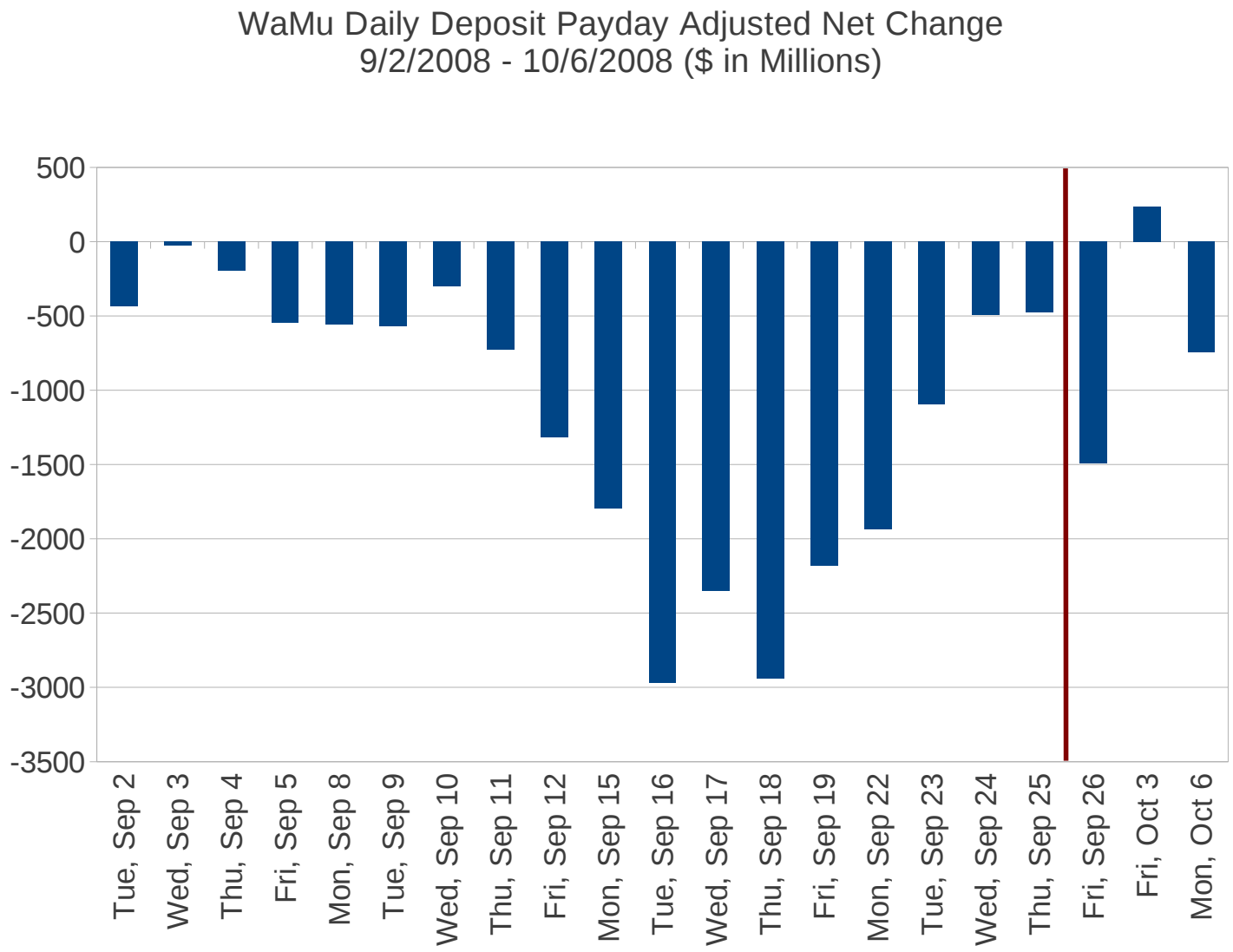
Zhiguo He
University of Chicago

Asaf Manela
Washington University in St. Louis

Bank Runs are Still with Us ...

- Financial crisis of 2007-2009 involved bank runs on Northern Rock, IndyMac, WaMu, and others
- Shadow banking
  - Run on Repo (Gorton-Metrick, 2011)
  - Run on ABCP Conduits (Acharya et al, 2011)

Bank Runs are Dynamic in Nature



Uncertainty and Learning are Key

- Redepositing into surviving banks: uncertainty is important
  - Iyer and Puri (forthcoming) provide redepositing evidence
- Learning and information acquisition considerations affect government disclosure policy
  - Stress tests: Can public provision of solvency information help curb the private acquisition of liquidity information?
  - Bailout of Big 9 banks on October 13, 2008. Paulson forces all banks to accept the bailout package to blur their differences

Uncertainty and Learning are Key

- Redepositing into surviving banks: uncertainty is important
  - Iyer and Puri (forthcoming) provide redepositing evidence
- Learning and information acquisition considerations affect government disclosure policy
  - Stress tests: Can public provision of solvency information help curb the private acquisition of liquidity information?
  - Bailout of Big 9 banks on October 13, 2008. Paulson forces all banks to accept the bailout package to blur their differences

This Paper and Related Literature

- We provide a dynamic bank run model with endogenous information acquisition
  - Endogenous information acquisition during rumor spreading may lead to multiple equilibria
  - Derive non-trivial minimum liquidity capacity to eliminate bank runs, which is in great contrast to static models
- Related literature
  - Diamond and Dybvig (1987), Chari and Jagannathan (1988), Goldstein and Pauzner (2005), Ennis and Keister (2008), Nikitin and Smith (2008), Gu (2011), etc
  - He and Xiong (2011), Achaya, Gale, and Yorulmazer (2011), Martin, Skeie, and von Thadden (2011) etc
  - Abreu and Brunnermeier (2002, 2003)

This Paper and Related Literature

- We provide a dynamic bank run model with endogenous information acquisition
  - Endogenous information acquisition during rumor spreading may lead to multiple equilibria
  - Derive non-trivial minimum liquidity capacity to eliminate bank runs, which is in great contrast to static models
- Related literature
  - Diamond and Dybvig (1987), Chari and Jagannathan (1988), Goldstein and Pauzner (2005), Ennis and Keister (2008), Nikitin and Smith (2008), Gu (2011), etc
  - He and Xiong (2011), Achaya, Gale, and Yorulmazer (2011), Martin, Skeie, and von Thadden (2011) etc
  - Abreu and Brunnermeier (2002, 2003)

Overview of Results

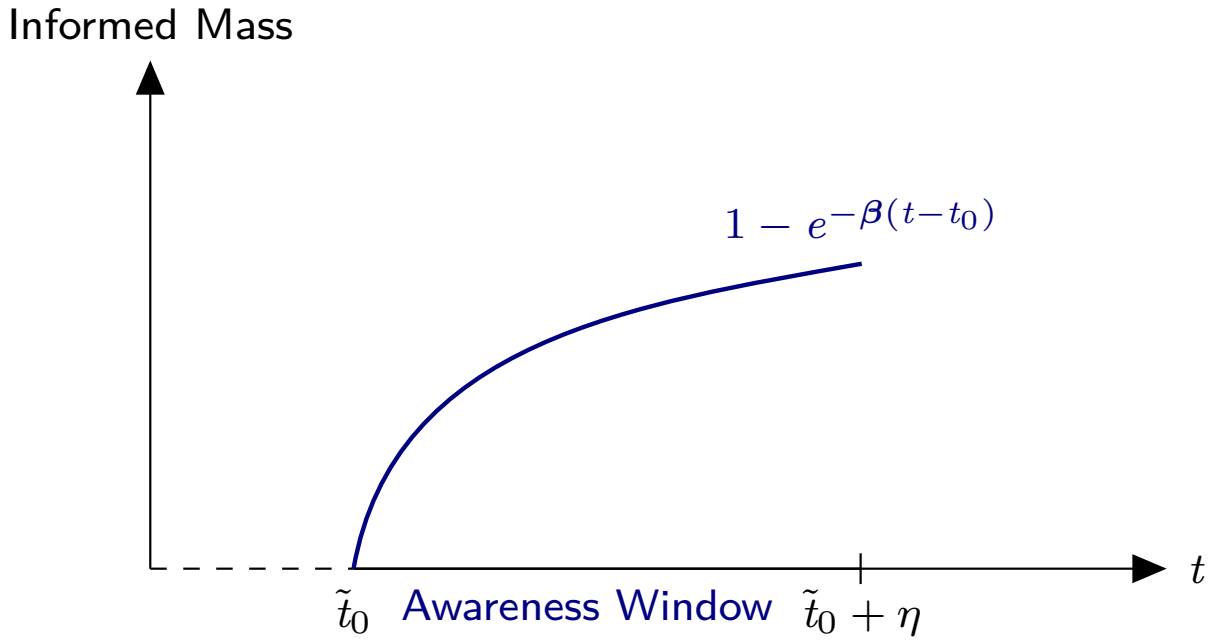
- Dynamic rumor-based bank run model with uncertainty
  - Rumor: signal about bank liquidity that lacks discernible source
  - Taking information acquisition effort as given, asynchronous timing of hearing the rumor allows us to derive the unique (responsive) bank run equilibrium
- But endogenous information acquisition may lead to multiple equilibria:
  - Good: nobody acquires information and nobody runs
  - Bad: everybody acquires information and runs on bank
- Study the minimum liquidity capacity that eliminates runs
- Extensions:
  - Insolvent banks
  - Competing banks

Bank Deposits

- Infinitely lived risk-neutral depositors with measure 1
- Bank deposits grow at a positive rate r, while cash under the mattress yields zero
- Bank is solvent, but fails if $\tilde{\kappa}$ measure of depositors withdraw
- When bank fails, each dollar inside the bank recovers $\gamma \in (0, 1)$

Liquidity Event and Spreading Rumors

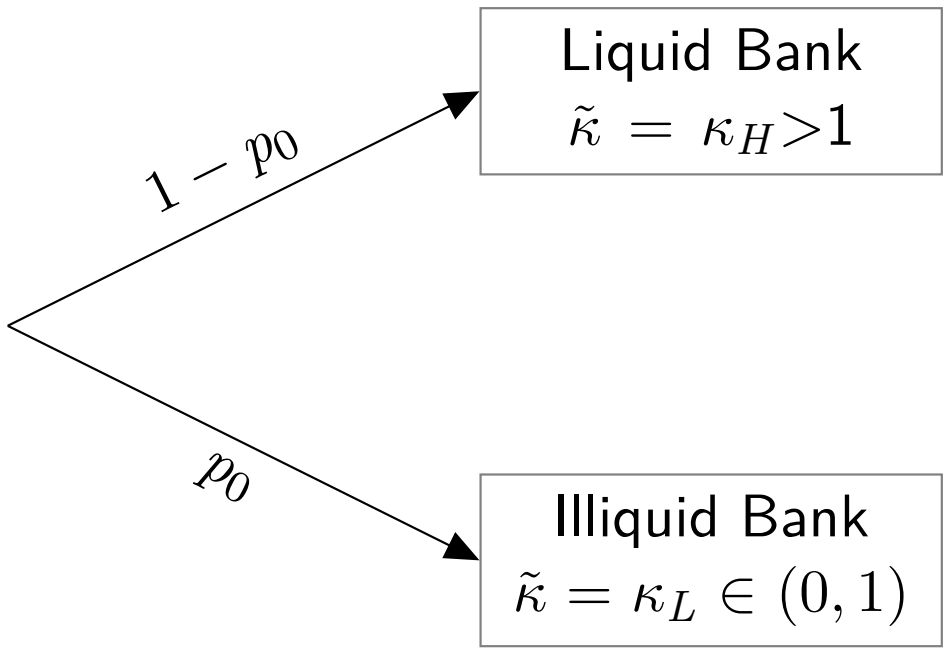
- At some random time $\tilde{t}_0$, a *liquidity event* hits the bank
- Bank may become illiquid and a *rumor* starts spreading



- Captures the essence of an unverified rumor of uncertain origin that spreads gradually

Uncertainty about Bank Liquidity

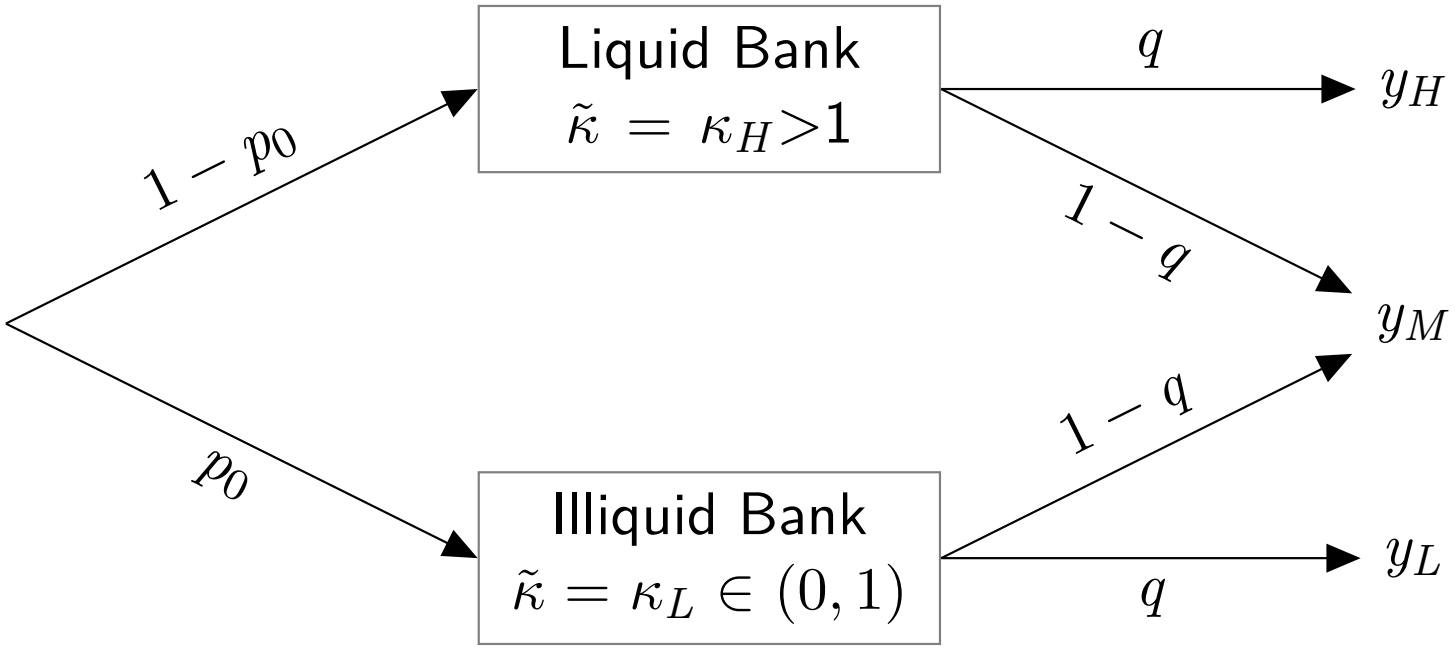
- The bank starts liquid, but at $\tilde{t}_0$ may become illiquid
- Bank liquidity $\tilde{\kappa}$ can take two values:



- If the bank is endogenously revealed to be liquid, agents *redeposit* their funds

Endogenous Information Acquisition

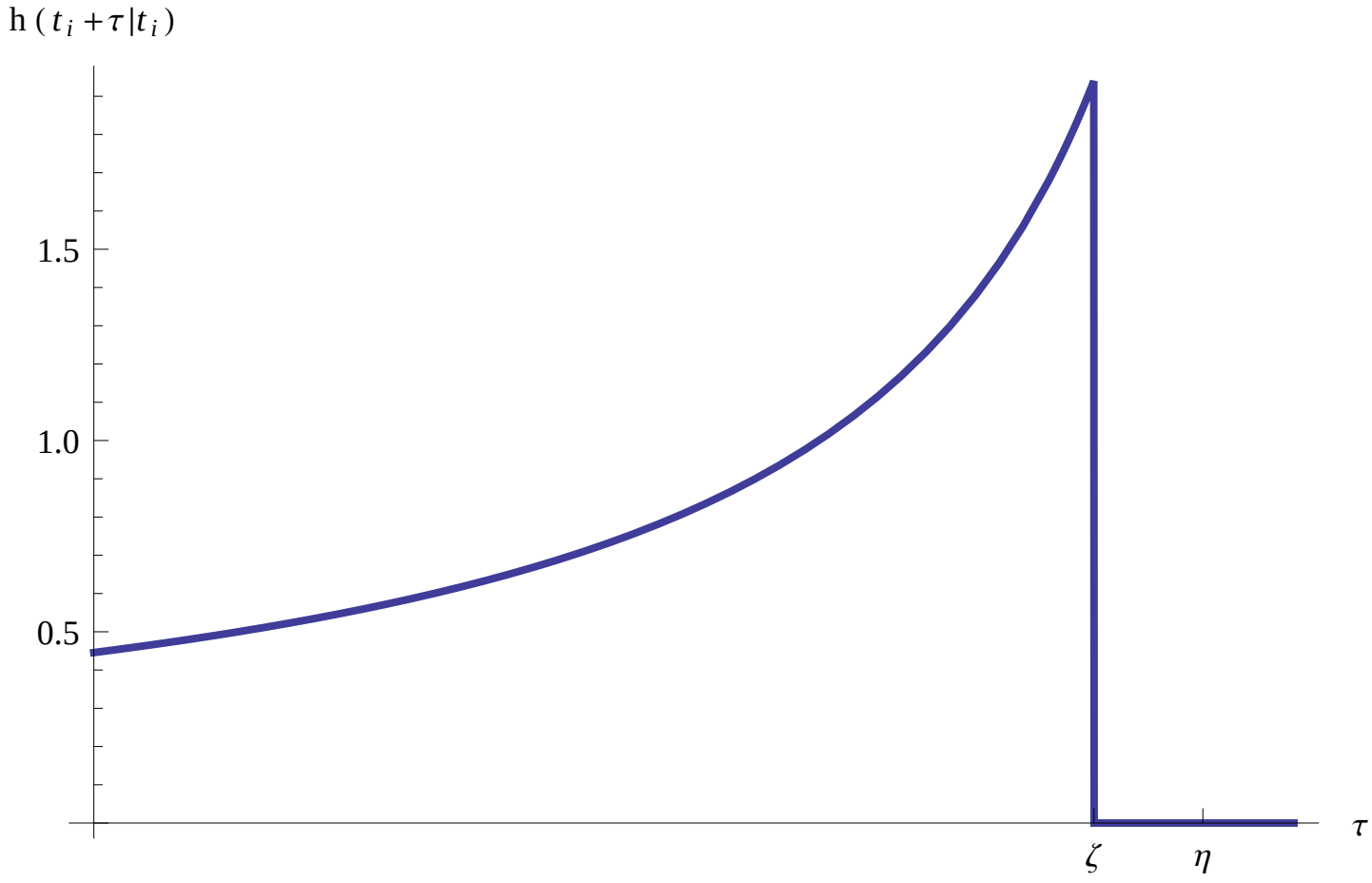
- When agent t_i hears the rumor, he can acquire an additional signal with quality q for convex cost $\frac{\alpha}{2}q^2$



- Pr. q perfect signals (y_H or y_L); Pr. $1-q$ uninformative (y_M)

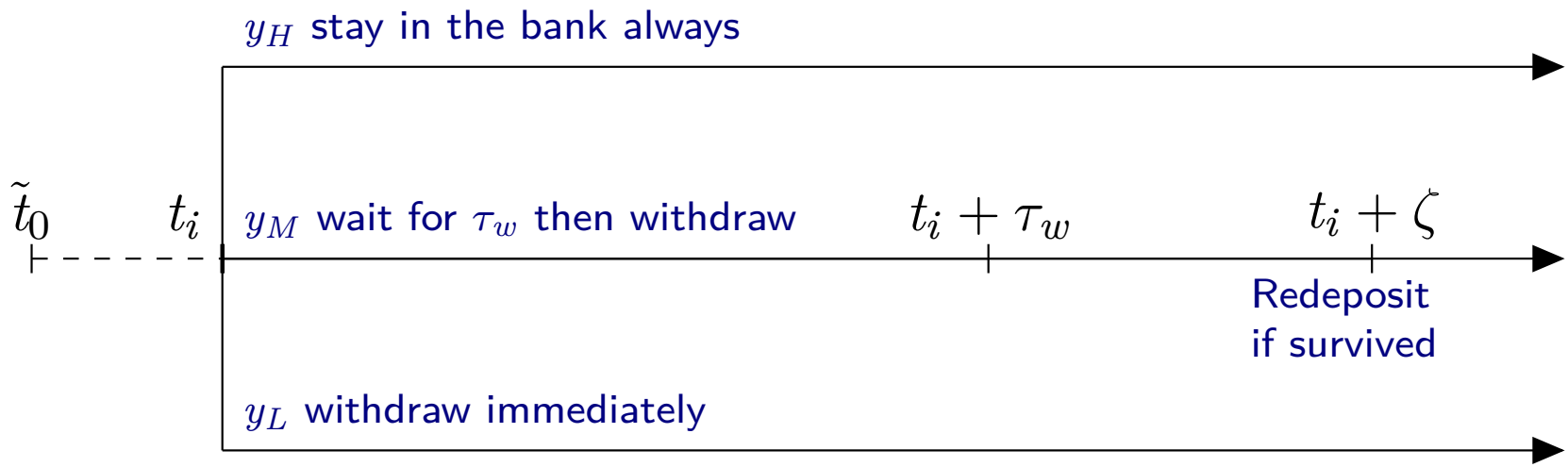
Dynamic Learning

- Let ζ denote the equilibrium survival time of illiquid bank
- Proposition 1. Failure Hazard Rate $h(\tau)$ over time:

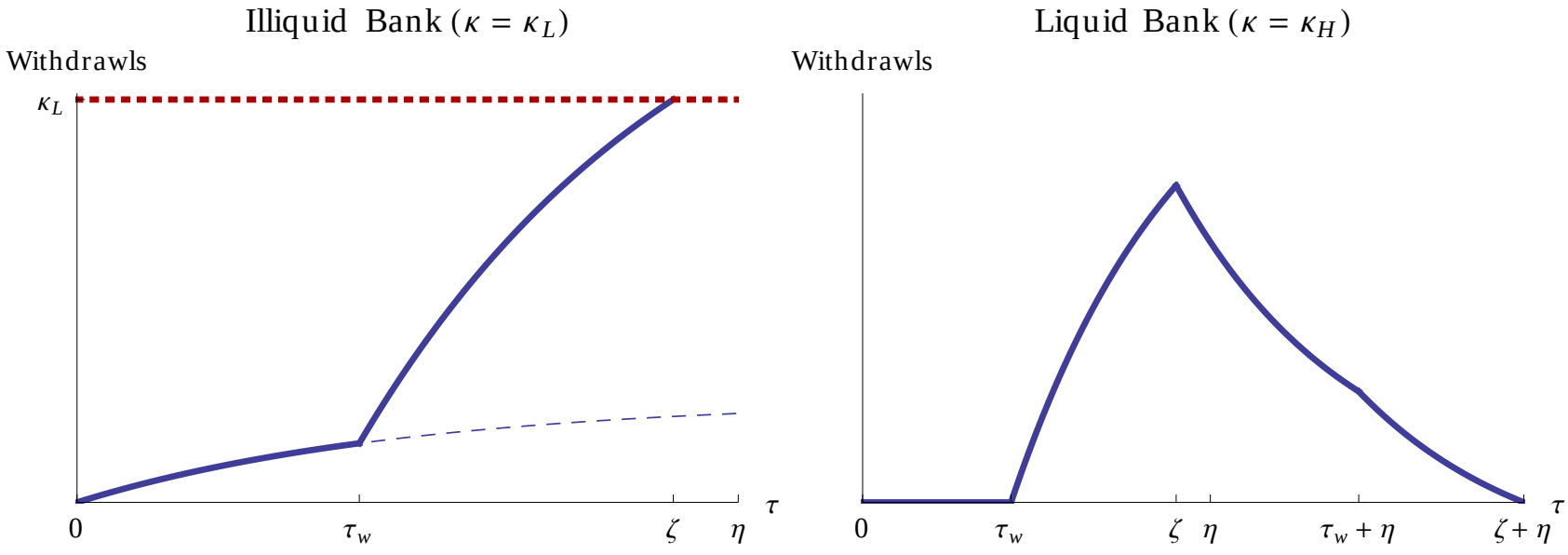


Individual Optimal Strategies

- Responsive symmetric equilibrium with endogenous waiting
- Proposition 2. *Given survival time ζ, threshold strategy is optimal.*



Bank Failure Condition



- Failure occurs when cumulative withdrawals reach the illiquid bank's capacity:

$$\kappa_L = q\left(1 - e^{-\beta\zeta}\right) + (1-q)\left(1 - e^{-\beta(\zeta - \tau_w)}\right)$$

- Combining with individual FOC gives $\{\zeta^*, \tau_w^*\}$, given q

Understanding the Bank Run Equilibrium

- Given q, the bank run equilibrium, if exists, is unique
- y_M's withdrawal decision: bank failure vs. r growth
  - Suppose all y_M agents withdraw immediately ($\tau_w = 0$), then
    - Few y_L agents have withdrawn, and it will be a while before the bank fails
    - Longer remaining survival time $\zeta - \tau_w$, lower failure hazard
  - When τ_w is greater, y_M agents know that more and more y_L agents have withdrawn before them
    - Shorter remaining survival time $\zeta - \tau_w$, higher failure hazard
- The heterogeneity of agents guarantees the unique equilibrium
- Bank runs may not exist, if waiting benefit always dominates
  - This allows us to study the minimum reserve to prevent runs

Understanding the Bank Run Equilibrium

- Given q, the bank run equilibrium, if exists, is unique
- y_M's withdrawal decision: bank failure vs. r growth
  - Suppose all y_M agents withdraw immediately ($\tau_w = 0$), then
    - Few y_L agents have withdrawn, and it will be a while before the bank fails
    - Longer remaining survival time $\zeta - \tau_w$, lower failure hazard
  - When τ_w is greater, y_M agents know that more and more y_L agents have withdrawn before them
    - Shorter remaining survival time $\zeta - \tau_w$, higher failure hazard
- The heterogeneity of agents guarantees the unique equilibrium
- Bank runs may not exist, if waiting benefit always dominates
  - This allows us to study the minimum reserve to prevent runs

Endogenous Information Acquisition

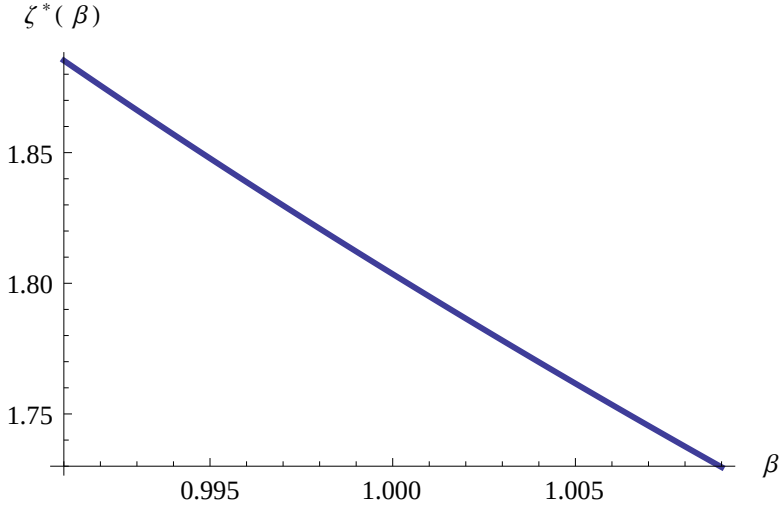
- FOC for information acquisition q^*:

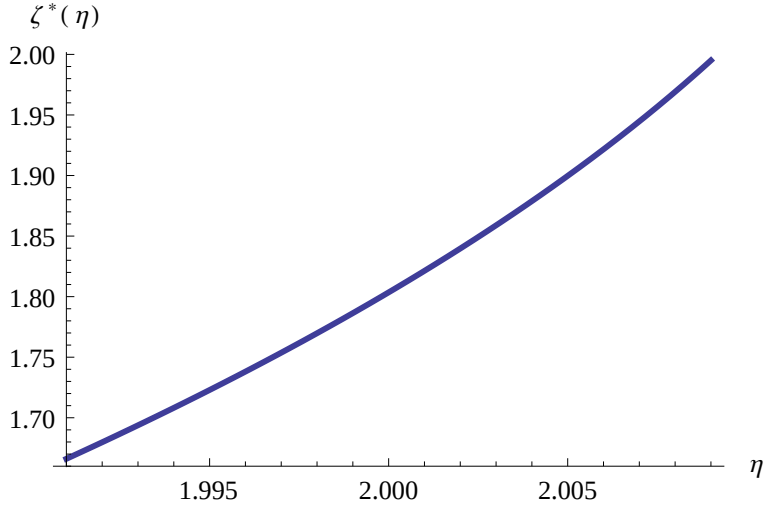
$$V_I\left(0|\text{informative signals}\right) - V_I\left(0|\text{uninformative signal}\right) = MC\left(q\right)$$

- Proposition 5. In general there are two equilibria
  1. Good equilibrium: not acquire info $q = 0 \Rightarrow$ bank run does not exist $\Rightarrow$ $q = 0$ is individually optimal
  2. Bad equilibrium: acquire info $q > 0 \Rightarrow$ bank run exists $\Rightarrow$ $q > 0$ is individually optimal

Comparative Statics

Survival Time ζ^* Response to Rumor Spreading Rate β and Awareness Window η





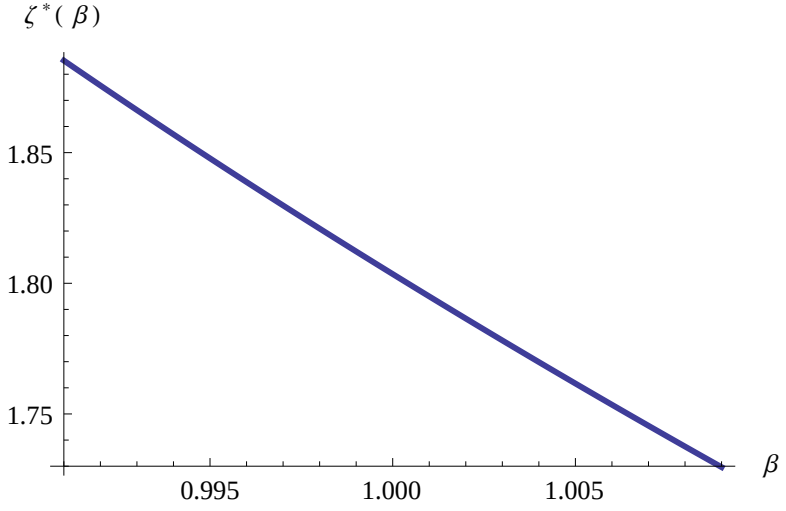
- Counter-intuitive: when the awareness window widens and potentially more agents run on the bank, the illiquid bank survives longer

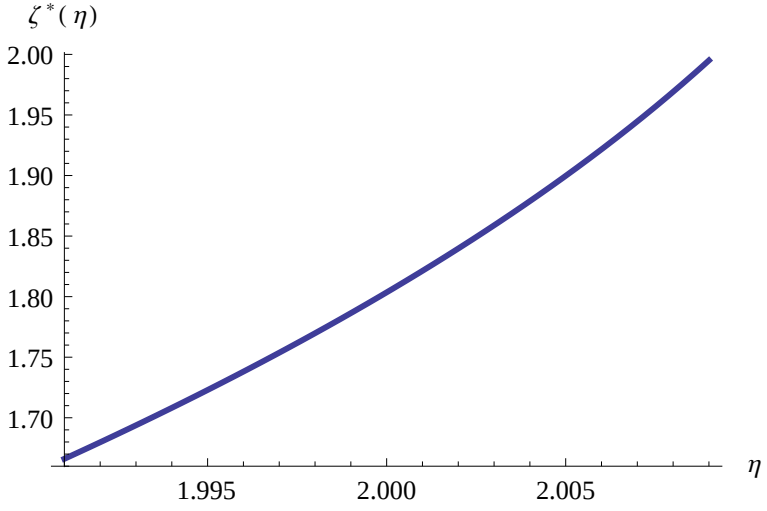
Key *The agent who hears the rumor also observes the bank is alive*

- Conditional on the bank surviving this long, the bank is more likely to be liquid

Comparative Statics

Survival Time ζ^* Response to Rumor Spreading Rate β and Awareness Window η





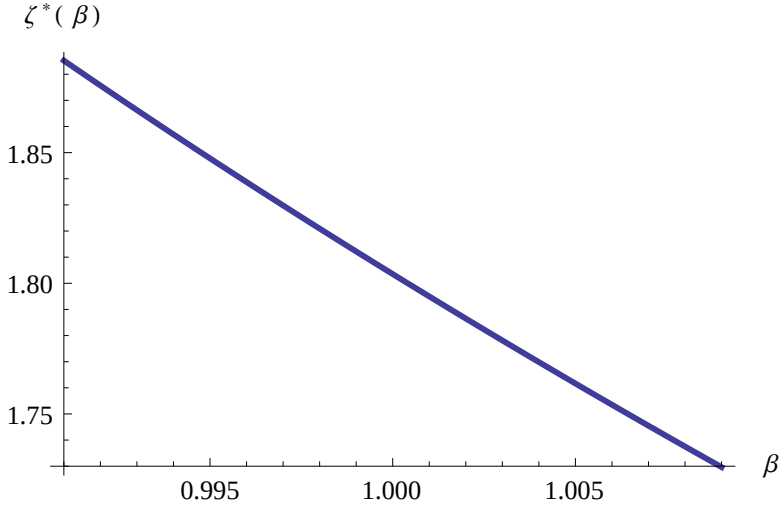
- Counter-intuitive: when the awareness window widens and potentially more agents run on the bank, the illiquid bank survives longer

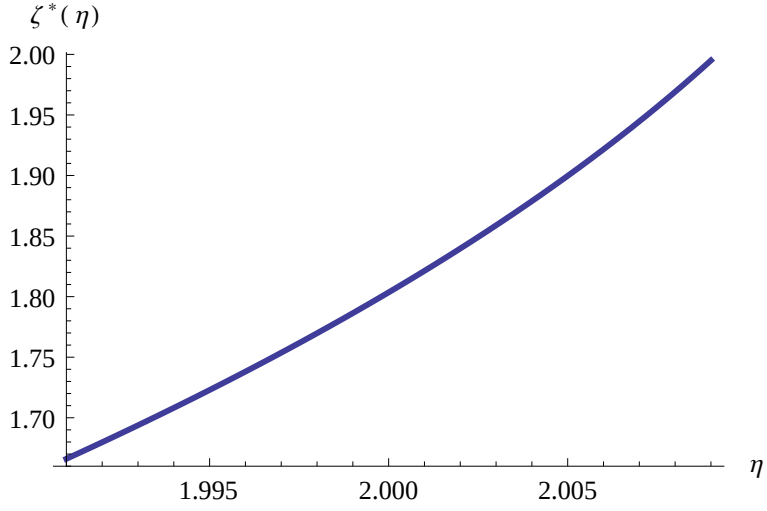
Key *The agent who hears the rumor also observes the bank is alive*

- Conditional on the bank surviving this long, the bank is more likely to be liquid

Comparative Statics

Survival Time ζ^* Response to Rumor Spreading Rate β and Awareness Window η



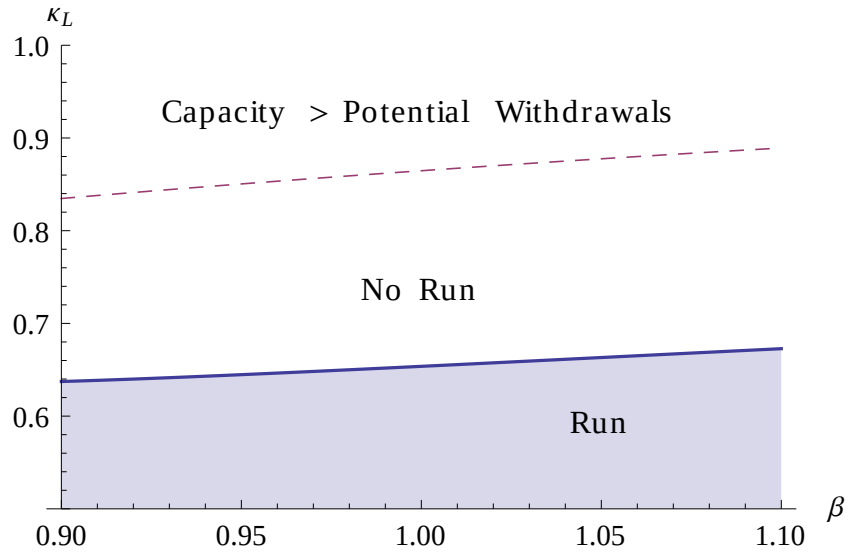


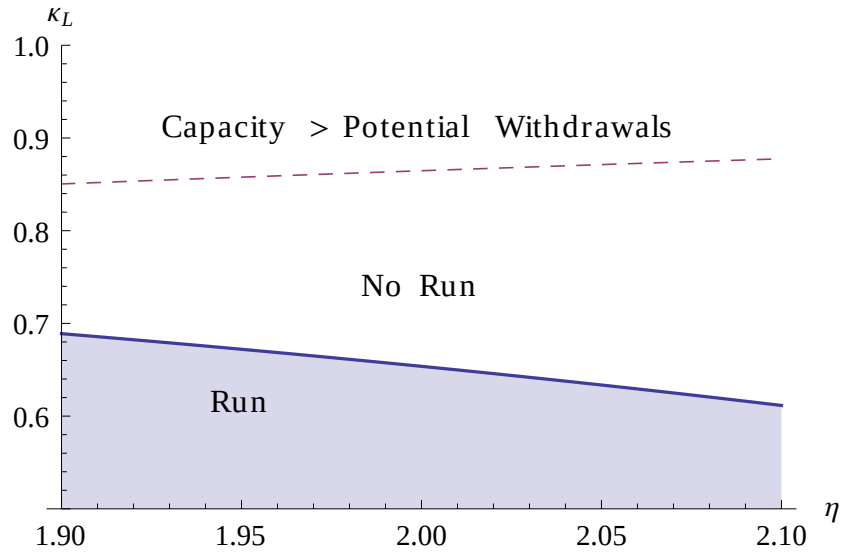
- Counter-intuitive: when the awareness window widens and potentially more agents run on the bank, the illiquid bank survives longer

Key *The agent who hears the rumor also observes the bank is alive*

- Conditional on the bank surviving this long, the bank is more likely to be liquid

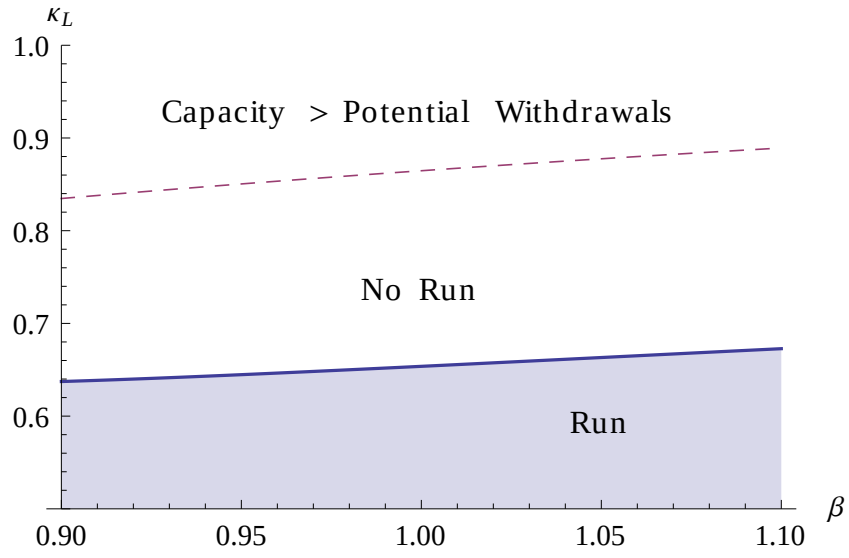
Minimum Reserve to Eliminate Bank Runs

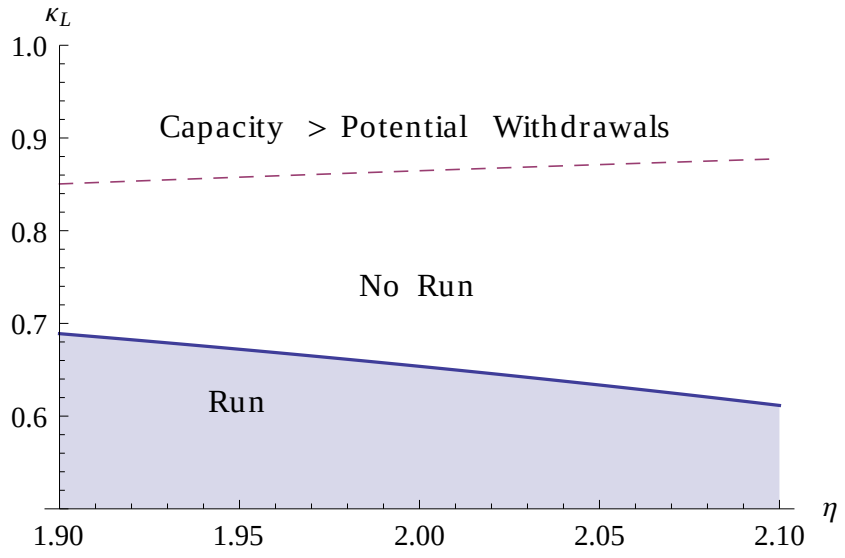




- We derive practically meaningful minimum reserve requirement to prevent runs from happening
  - It is below the level implied by static (Diamond-Dybvig) models
- The wider the awareness window, the less severe the runs

Minimum Reserve to Eliminate Bank Runs





- We derive practically meaningful minimum reserve requirement to prevent runs from happening
  - It is below the level implied by static (Diamond-Dybvig) models
- The wider the awareness window, the less severe the runs

Awareness Window Effect: Subprime Mortgage Crisis

- May 17, 2007: Bernanke indicates in a speech about the subprime mortgage market that looser lending standards where pervasive especially in loans originated in 2006
- Subsequently, ABCP conduits experienced a "bank run"
  - ABCP outstanding dropped from $1.3 trillion in July 2007 to $833 billion in December 2007 (Acharya et al; 2011)
- Speech signaled the awareness window is relatively short
- What if the problem of looser lending standards had started earlier in 2003?

Extension: Insolvent Banks and Stress Tests

- Information and runs can be socially good with insolvent banks
- Studying *solvency* inevitably tells us something about *liquidity*
- Public provision of solvency information crowds out individual's effort to acquire liquidity information
- E.g.: Stress tests

Extension: Switching between Two Banks

- Often agents move funds from weak banks to stronger ones
- Highly inefficient
- Injecting noise about solvent competing banks increases the cost of liquidity information $\Rightarrow$ can eliminate runs
- E.g.: Paulson forces strongest banks to participate in 2008 Bailout

Conclusion

- Individuals acquire information excessively when bank runs are a concern
- Government can play an active role in information policy
- Several intriguing results unique to our dynamic learning framework
  - Spreading speed and awareness window
  - Nontrivial minimum liquidity capacity to eliminate bank runs
- Our dynamic model can be taken to data, if available