

# Adverse Selection, Reputation and Sudden Collapses in Securitized Loan Markets

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November 29, 2010

## Collapses in Securitized Markets ---

- New issuances of asset-backed securities seem to collapse abruptly
- Collapses associated with fall in collateral values of underlying loans
- Policymakers perceive collapses as associated with increased inefficiency
- Policymakers propose policies intended to remedy increased inefficiency

## What We Do

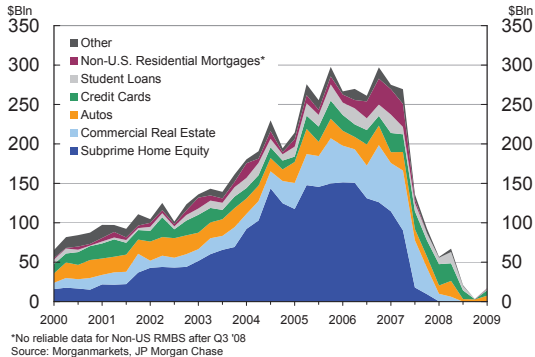
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- Develop model with abrupt collapses in securitized loan markets
- Collapses in model associated with increased inefficiency
- Collapses in model associated with fall in collateral values
- Use model to evaluate actual and proposed policies

# Illustration of Abrupt Collapses

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## New Issuances of ABSs in 2000s

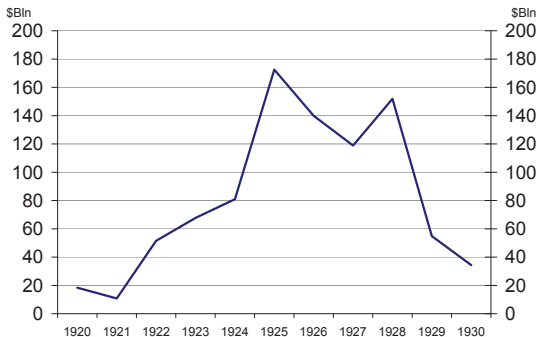


- Market collapsed in Aug 2007, Land prices fall in 2007

## Illustration of Abrupt Collapses

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### Change in Stock of Real Estate Bonds in 1920s



**Note:** Data is annual change in real estate bonds divided by Nominal GDP at relevant year multiplied by Nominal GDP 2009.

**Source:** Carter, et. al., Historical Statistics, (2006)Series Dc904

- Market collapsed in Aug 1929

## Perception of Increased Inefficiency ---

- Treasury Department on Public-Private Partnership, 2009:  
“Secondary markets have become highly illiquid, and are trading at prices below where they would be in normally functioning markets.”
- NY FED on TALF, 2009:  
“Nontraditional investors such as hedge funds, which may otherwise be willing to invest in these securities, have been unable to obtain funding from banks and dealers because of a general reluctance to lend.”

## Our Contribution

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- Analyze role of reputation in adverse selection models
- Show reputation and adverse selection lead to inefficiency and fragility
- Fragility:
  - Multiple Equilibria
  - Small aggregate shock to collateral values causes big aggregate fluctuations

## Fragility

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- Fall in collateral value exacerbates adverse selection problem
- Induces fluctuations in volume for bank with particular reputation
- Dynamics induce clustering of reputations
- Fall in collateral value can induce **large** fluctuations in volume

## Policy Analysis

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- Toxic asset purchases do not work  
e.g., Public-Private Partnership Program, TALF
  - Big transfer to banks
  - At best, leaves allocations unchanged
- Decrease in financing cost does not work  
e.g., increased FDIC guarantees
  - Exacerbates the adverse selection problem
  - At best, leaves allocations unchanged

## Related Literature

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- Adverse Selection in asset markets: Garleanu-Pedersen, Duffie-DeMarzo
- Reputation literature: Milgrom-Roberts, Kreps-Wilson, Mailath-Samuelson, Ordonez
- Global Games: Carlson-Van Damme, Morris-Shin
  - Noisy private signals can resolve coordination problems
  - Fragility
- Policy Analysis: Phillipon and Skreta 2009

## Related Literature: Evidence of Asymmetric Information

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- Loan originators/bank: more information than loan purchasers
- Downing, Jaffee, and Wallace 2009: Higher ex-post return for unsecuritized loans
- Drucker and Mayer 2008: Underwriters' behavior in secondary market:
  - Bid on good ex-post tranches
  - Avoid bidding on bad ex-post tranches

## Related Literature: Evidence of Asymmetric Information

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- Elul 2009:
  - Returns on securitized and held loans similar before 2006
  - Returns on securitized loans lower after 2006
- Ivashina 2009: Evidence of information asymmetry in syndicated loans
- Benmelech, et. al 2010: No difference in CLOs
- Sufi and Mian 2009: Securitized loans more likely to default than non-securitized loans

## Outline

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- Securitized Loan Market Model
- Characterize Equilibria with Private Information:  
Multiplicity
- Perturbation: Uniqueness and Fragility
- Policy Analysis

# SECURITIZED LOAN MARKET MODEL

## Environment

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- 2 period model - extended in paper to any horizon
- 1 Bank and competitive buyers
- All are risk neutral
- Bank's discount factor:  $\beta$
- Buyers live for one period

## Bank's Quality Type

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- Bank quality type, indexed by loan quality:  $\pi$ 
  - Two quality types:  $\pi \in \{\underline{\pi}, \bar{\pi}\}$ ,  $\underline{\pi} < \bar{\pi}$
  - Quality type persistent: same for both periods
- Bank of type  $\pi$  originates a loan with returns:
  - $v = \bar{v}$  with Prob.  $\pi$
  - $v = \underline{v}$  with Prob.  $1 - \pi$
- Initial prior on Bank's type:  $\mu_1 = Pr(\pi = \bar{\pi})$

## Bank's Cost Type

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- Bank's cost of holding loan relative to the market-place:
  - $c \in \{\underline{c}, \bar{c}\}$ ,  $\underline{c} < 0 < \bar{c}$
  - $c$  i.i.d. across periods
  - $Pr(c = \underline{c}) = \alpha$
  
- Cost represents specialization benefits:
  - Servicing costs
  - Default renegotiation costs
  - Risk tolerance or covariance of loan with bank's portfolio
  - Funding liquidity shocks

## Bank

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- Bank indexed by quality type and cost type:  $(\pi, c)$
- Bank types are private information
- After origination, bank chooses to sell or hold loan

## Markets

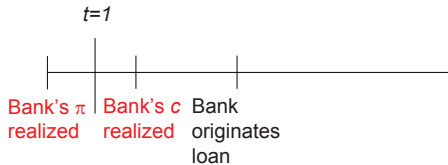
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- Securitized Loan Market:
  - Buyers offer price for any assets for sale:  $p$
- Buyers make simultaneous offers

# Timing

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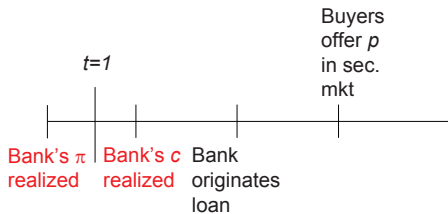
- red: private information



# Timing

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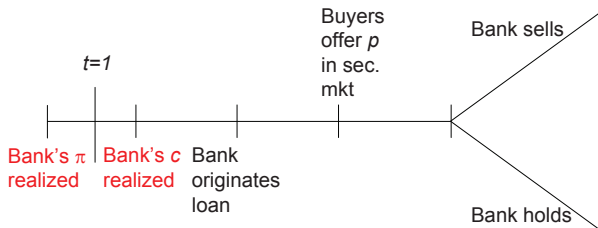
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# Timing

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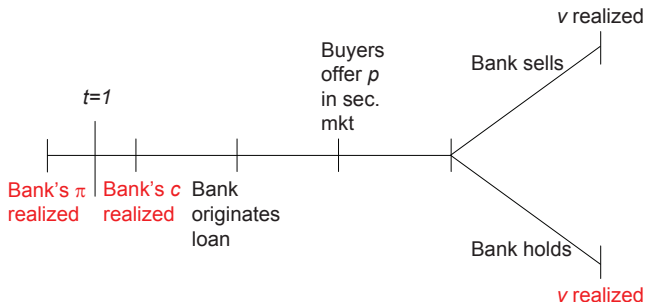
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# Timing

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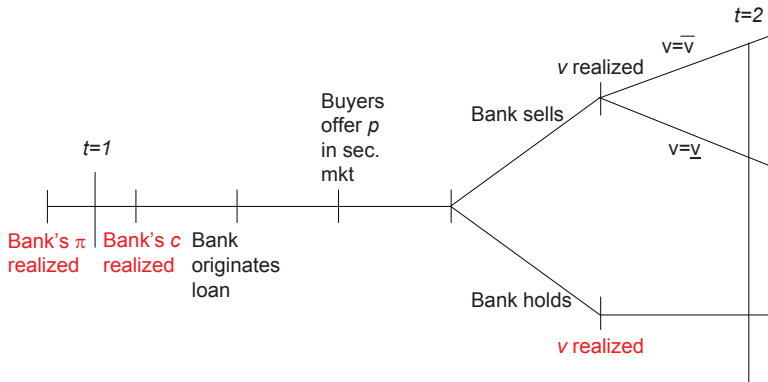
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# Timing

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- red: private information



## Bank Payoffs

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- Bank type:  $(\pi, c)$
- Period Payoffs (Normalize  $\underline{v} = 0$  for now)

- Sell:

$$p$$

- Hold:

$$\pi \bar{v} - c$$

## Buyer Payoffs

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- Buyer payoffs:

$$E_{\pi,c} [v | (\pi, c) \text{ sells}] - p$$

# Equilibrium

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- We consider Perfect Bayesian Equilibrium of this game
- Bertrand competition among buyers in each period

## Full Information Benchmark ---

- Bank sells if and only if

$$p \geq \pi \bar{v} - c$$

- For known quality type, break even prices are

$$p = \pi \bar{v}$$

- At break even prices:

$$\pi \bar{v} \geq \pi \bar{v} - c$$

$\Rightarrow$  sell if and only if  $c \geq 0$

## Full Information Benchmark ---

- Hold/Sell decision depends only on costs – not on  $\pi$
- $(\cdot, \underline{c}) \rightarrow$  Bank has comparative advantage: hold
- $(\cdot, \bar{c}) \rightarrow$  Market has comparative advantage: sell
- Efficiency: allocate loans to agents with comparative advantage

# CHARACTERIZING EQUILIBRIA WITH PRIVATE INFORMATION

## Equilibria with Private Information ---

We will show:

- Uniqueness in the static game/last period
- Multiplicity in dynamic game
- Multiplicity only because of reputation

## Simplification

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- Can show in any equilibrium, in each period and after every history
  - $(\cdot, \underline{c})$  : hold loans
  - $(\underline{\pi}, \bar{c})$  sells loans
- Focus on high quality, high cost bank  $(\bar{\pi}, \bar{c})$
- For presentation, fix decisions of remaining banks:
  - $(\cdot, \underline{c})$  hold
  - $(\underline{\pi}, \bar{c})$  sell

CHARACTERIZING EQUILIBRIA WITH PRIVATE INFORMATION  
LAST PERIOD/STATIC GAME

## Characterizing Equilibria

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- Unique equilibrium which depends on parameter  $\mu_2$

$\mu_2$ : reputation in dynamic model

- If  $\mu_2$  is low: Lemons problem
  - Price is low
  - $(\bar{\pi}, \bar{c})$  bank holds loan
- If  $\mu_2$  is high: No lemons problem
  - Price is high
  - $(\bar{\pi}, \bar{c})$  bank sells loan

## Break Even Prices

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- Two candidate equilibrium prices:

$$(\bar{\pi}, \bar{c}) \text{ bank sells: } p_{sell}(\mu_2) = (\mu_2 \bar{\pi} + (1 - \mu_2) \underline{\pi}) \bar{v}$$

$$(\bar{\pi}, \bar{c}) \text{ bank holds: } p_{hold} = \underline{\pi} \bar{v}$$

## Static Equilibrium Characterization

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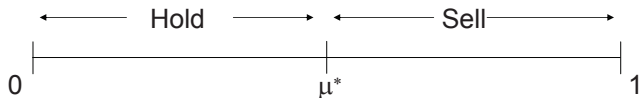
- Selling is an equilibrium if and only if

$$p_{sell}(\mu_2) \geq \bar{\pi}\bar{v} - \bar{c}$$

- There exists  $\mu^*$  such that  $(\bar{\pi}, \bar{c})$  bank is indifferent
- If  $\mu_2 \geq \mu^*$ , Selling is optimal; Bertrand Competition
- If  $\mu_2 < \mu^*$ , Holding is optimal
- $\mu^*$  critical threshold, above which  $(\bar{\pi}, \bar{c})$  bank sells in equilibrium

## How Equilibrium Depends on Reputation \_\_\_\_\_

- Last period equilibrium depends only on reputation,  $\mu_2$

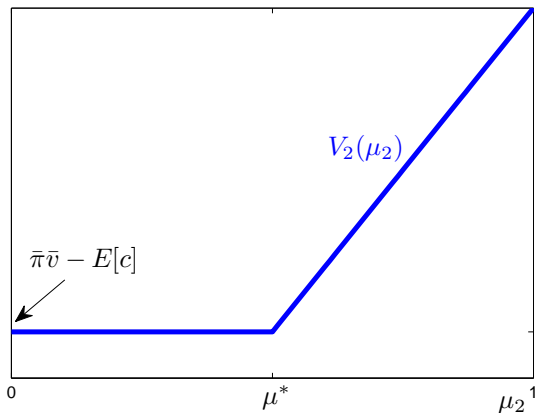


- Defines a value function  $V_2(\mu_2)$ : increasing and convex.

## Summarizing Equilibrium

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- Bank's last period ex-ante cost Value Function



## Efficiency of Equilibrium in a Static Model \_\_\_\_\_

- Can show equilibrium is interim efficient
- Argument similar to Myerson (1983)
- Obvious point: Adverse Selection does not necessarily imply inefficiency

# CHARACTERIZING EQUILIBRIA WITH PRIVATE INFORMATION FIRST PERIOD

## Characterizing Equilibria

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- Focus on period 1 strategies and learning rule
- Unique equilibrium for extreme reputations
- Multiple equilibria for intermediate reputations

## Characterizing Equilibria ---

- Multiple equilibria for intermediate reputations:

## Characterizing Equilibria

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- Multiple equilibria for intermediate reputations:
  - Positive Reputational Equilibrium:
    - First period price is high
    - $(\bar{\pi}, \bar{c})$  bank sells loan in the 1st period

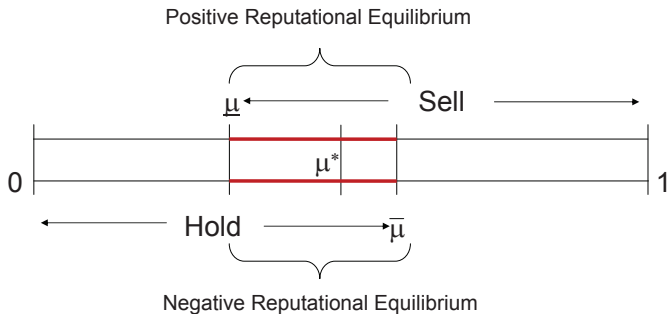
## Characterizing Equilibria

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- Multiple equilibria for intermediate reputations:
  - Positive Reputational Equilibrium:
    - First period price is high
    - $(\bar{\pi}, \bar{c})$  bank sells loan in the 1st period
  - Negative Reputational Equilibrium:
    - First period price is low
    - $(\bar{\pi}, \bar{c})$  bank holds loan in the 1st period

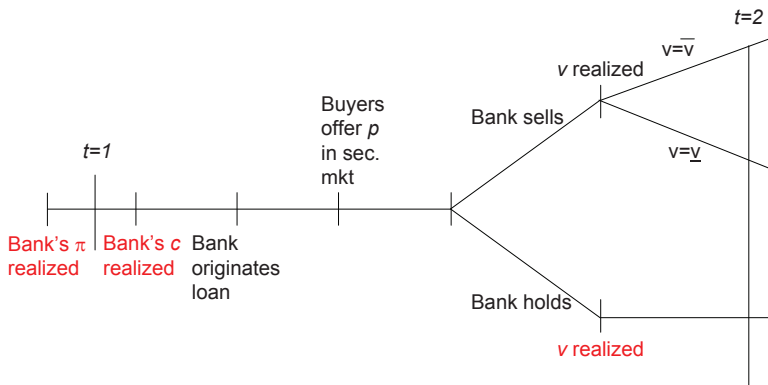
# Multiple Equilibria

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# Recall Timing

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## Bank's Best Response

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- Value of Sell:

$$p + \beta(\bar{\pi}V_2(\mu_{s\bar{v}}) + (1 - \bar{\pi})V_2(\mu_{s0}))$$

- Value of Hold:

$$\bar{\pi}\bar{v} - \bar{c} + \beta V_2(\mu_h)$$

- Selling optimal if and only if:

$$p_{sell}(\mu_1) + \underbrace{\beta [\bar{\pi}V_2(\mu_{s\bar{v}}) + (1 - \bar{\pi})V_2(\mu_{s0}) - V_2(\mu_h)]}_{\text{reputational gain}} \geq \bar{\pi}\bar{v} - \bar{c}$$

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- $\mu_{s\bar{v}}, \mu_{s0}, \mu_h$  different in two equilibria

# Updating by Future Buyers

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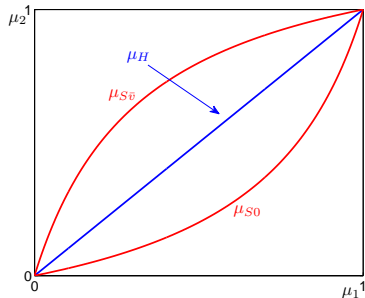
Positive Beliefs:

$(\bar{\pi}, \bar{c})$  sells

$(\underline{\pi}, \bar{c})$  sells

$(\cdot, \underline{c})$  holds

Signal used to update



## Updating by Future Buyers

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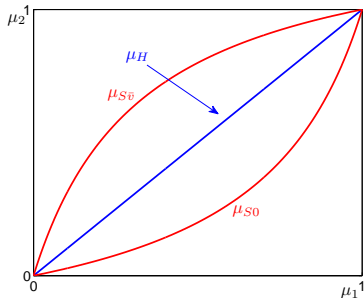
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Signal used to update



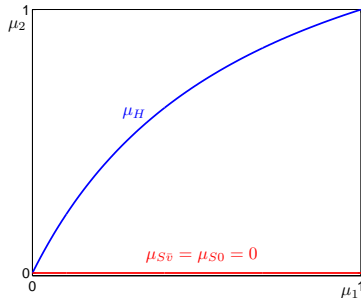
Negative Beliefs:

$(\bar{\pi}, \bar{c})$  holds

$(\underline{\pi}, \bar{c})$  sells

$(\cdot, \underline{c})$  holds

Signal ignored in updating



## Bank's Best Response, Positive Beliefs \_\_\_\_\_

- Positive beliefs: selling allows future buyers to see asset quality
- $(\bar{\pi}, \bar{c})$  bank has bigger incentive to sell than in static model
- For  $\mu_1 < \mu^*$  (Static Cutoff),

$$\bar{\pi}V_2(\mu_{s\bar{v}}) + (1 - \bar{\pi})V_2(\mu_{s0}) - V_2(\mu_h) > 0$$

by convexity of  $V_2$  and learning ( $E\mu \geq \mu_1 = \mu_h$ )

- $(\bar{\pi}, \bar{c})$  banks with reputation below static threshold also sell

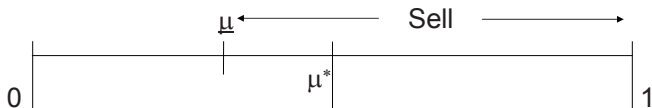
## Positive Reputational Equilibrium

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### Proposition

There exists an equilibrium in which  $(\bar{\pi}, \bar{c})$  bank chooses

- sell for  $\mu_1 \in [\underline{\mu}, 1]$ ,
- $\underline{\mu} < \mu^*$



## Bank's Best Response, Negative Beliefs \_\_\_\_\_

- Negative beliefs: selling signals low quality type, independent of realized return
- $(\bar{\pi}, \bar{c})$  bank has bigger incentive to hold than in static model
- For  $\mu_1 > \mu^*$ ,

$$\bar{\pi}V_2(\mu_{s\bar{v}}) + (1 - \bar{\pi})V_2(\mu_{s0}) - V_2(\mu_h) < 0$$

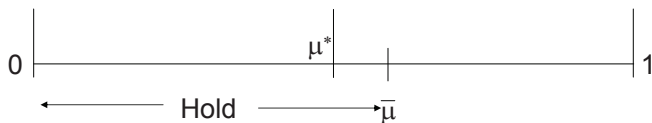
- $(\bar{\pi}, \bar{c})$  banks with reputation above static threshold also hold

## Negative Reputational Equilibrium \_\_\_\_\_

### Proposition

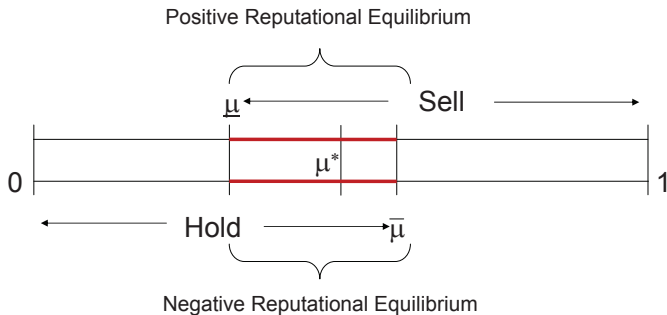
*There exists an equilibrium in which  $(\bar{\pi}, \bar{c})$  bank chooses*

- hold for  $\mu_1 \in [0, \bar{\mu}]$
- $\bar{\mu} > \mu^*$



# Multiplicity

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- For  $\mu_1 \in [\underline{\mu}, \bar{\mu}]$ , Multiplicity of equilibria

- Interim Dominance
  - Under sufficient conditions, positive outcome interim dominates negative
- Ex-ante Dominance
  - Under sufficient conditions, positive outcome ex-ante dominates negative

## Multiplicity

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- Multiplicity can be interpreted as fragility
- Suppose sunspot induces shift to negative equilibrium
- Can induce sudden collapse
- Sunspot can be fall in collateral values

## Multiplicity

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- Cannot do policy analysis with multiple equilibria
- Need refinement
- Our perturbation:
  - Shocks to default values of collateral
  - Unique and fragile equilibrium

## ADDING AGGREGATE SHOCKS

## Aggregate Shocks

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- Default value  $\underline{v} \sim F(\underline{v})$
- In static model,  $(\bar{\pi}, \bar{c})$  sells if

$$[\mu\bar{\pi} + (1 - \mu)\underline{\pi}] \bar{v} + [\mu(1 - \bar{\pi}) + (1 - \mu)(1 - \underline{\pi})] \underline{v} \geq \bar{\pi}\bar{v} + (1 - \bar{\pi})\underline{v} - \bar{c}$$

or, setting  $\Delta v = \bar{v} - \underline{v}$

$$[\mu\bar{\pi} + (1 - \mu)\underline{\pi}] \Delta v \geq \bar{\pi}\Delta v - \bar{c}$$

- Fall in  $\underline{v}$  implies  $\Delta v$  increases
- Raises  $\mu_2^*$

## Aggregate Shocks and Fragility ---

- In static model, can get fragility if many banks reputations are clustered
- No reason to expect this
- Perturbation yields unique equilibrium
- Dynamic model yields clustering

## Aggregate Shocks and Perturbation

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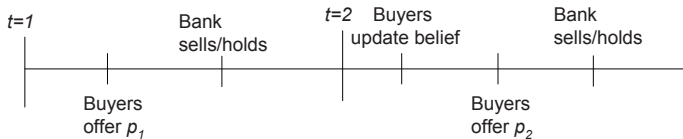
- $\underline{v}$  a random variable,  $\underline{v} \sim F(\underline{v})$
- Banks and buyers in period 1 observe signal of  $\underline{v}$ :

$$v_1 = \underline{v} + \sigma\epsilon, \quad E\epsilon = 0, \quad E[\underline{v}|v_1] = v_1$$

- Period 2 buyers do not observe  $v_1$  or prices in period 1
- Bank and period 2 buyers observe  $\underline{v}$

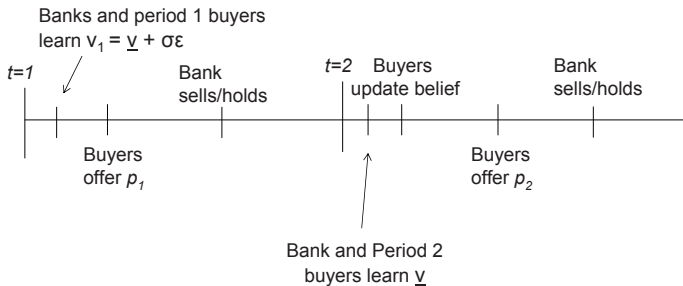
# Perturbation

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# Perturbation

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## Uniqueness of Equilibrium

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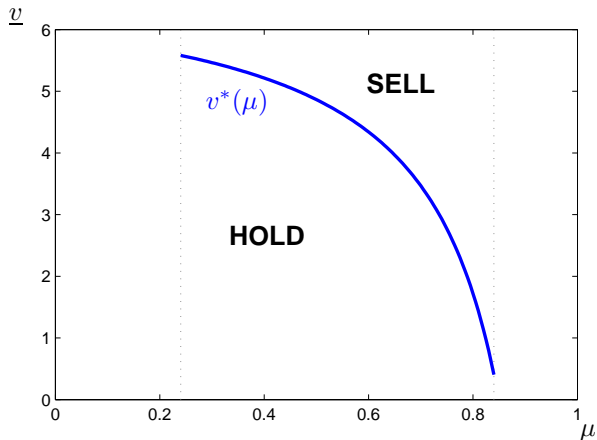
### Theorem

*As  $\sigma \rightarrow 0$ , the set of equilibrium strategies for the  $(\bar{\pi}, \bar{c})$  bank converges to a unique strategy given by*

- *Sell if  $v_1 \geq v_1^*$ ,*
- *Hold if  $v_1 < v_1^*$ .*

## Cutoff Thresholds

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## Idea of Proof

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- Reputational incentives depend on future buyer's belief about  $(\bar{\pi}, \bar{c})$  bank's action in 1st period
- Reputational incentives are bounded
- Dominance regions:
  - Very high  $v_1$ :  $(\bar{\pi}, \bar{c})$  bank sells independent of future beliefs
  - Very low  $v_1$ :  $(\bar{\pi}, \bar{c})$  bank holds independent of future beliefs

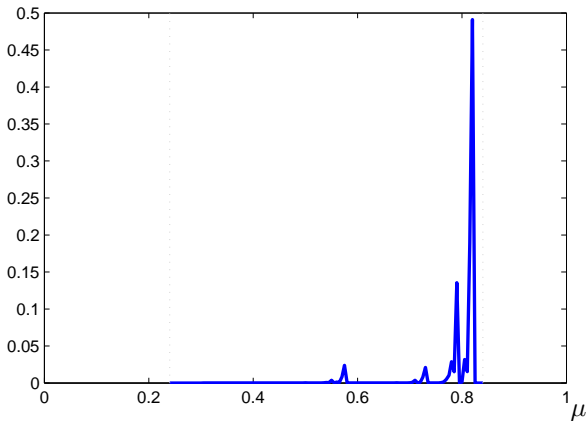
## Idea of Proof

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- Limit dominance  $\rightarrow$  restrictions on learning
- Restricted learning: tighter bounds on reputational incentives
- Iterating in this manner: Convergence

## Invariant Distribution of Reputation

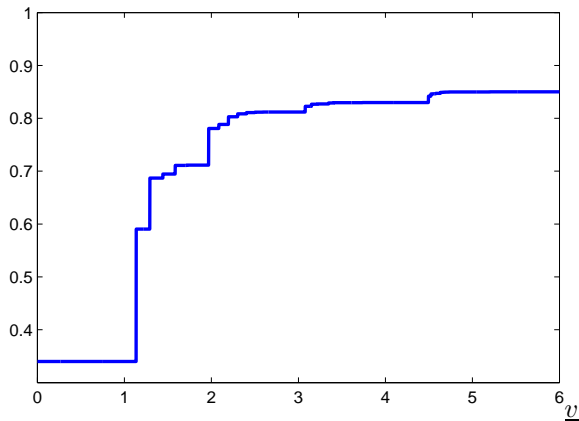
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- Invariant distribution of reputations of  $\bar{\pi}$  banks (with exogenous replacement)

# Volume of Trade

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## Sudden Collapses

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- Have shown sudden adverse selection plus learning means sudden collapses can affect many banks
- Shocks to collateral values can lead to big effects on aggregate new issues

# POLICY ANALYSIS

POLICY ANALYSIS  
POLICIES THAT DO NOT WORK

## Loan Purchase Policies

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- Public-Private Partnership for Legacy Assets
- TALF

## Loan Purchase Policies ---

- Consider the selected unique equilibrium of two period game:
- Recall: low collateral value: hold, high collateral value: sell
- Contingent on a low collateral value, government offers to buy loans
  - Government uses prices associated with positive reputational equilibrium

## Loan Purchase Policies

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- Equivalent to an offer by buyer
- Gov't policy has no effect on reputational gain
- Negative reputational outcomes still equilibrium
- Loan purchase policy induces no change in bank behavior
- Loan purchase policy results in transfer to  $(\underline{\pi}, \bar{c})$  banks

## Policies Subsidizing Debt Finance \_\_\_\_\_

- Government reduces interest rates in period 1
- Greater incentives to hold rather than sell
- Worsens lemons problem
- Negative reputational outcomes still equilibrium

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- Negative reputational outcomes still equilibrium
- Real world policies: Increase in FDIC guarantees

## Policies Subsidizing Debt Finance\_\_\_\_\_

- Government reduces interest rates in period 2
- Unperturbed game: smaller region for multiplicity in period 1
- Perturbed game: Ambiguous
- Interest rate policy: time inconsistent

POLICY ANALYSIS  
POLICIES THAT MIGHT WORK

## Forced Loan Sales

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- Government forces banks to sell random fraction of loans
  - No lemons problem
  - Loses comparative advantage benefit

## Commitment to Future Purchases Policy\_\_\_\_\_

- Suppose government can commit to making future purchases contingent on signals.
- Solves multiplicity problem
- Why can't private agents commit?

## Future Work

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- Endogenize loan origination
  - What effect does secondary market collapse have on origination?
  
- Uniquely implement the efficient equilibrium

## Conclusions

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- Develop model with sudden collapses
- Sudden collapses associated with increased inefficiency
- Sudden collapses likely when collateral values fall
- Proposed and implemented policies do not work
- Other policies might be better