Adverse Selection, Reputation and Sudden Collapses in Securitized Loan Markets

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Collapses in Securitized Markets

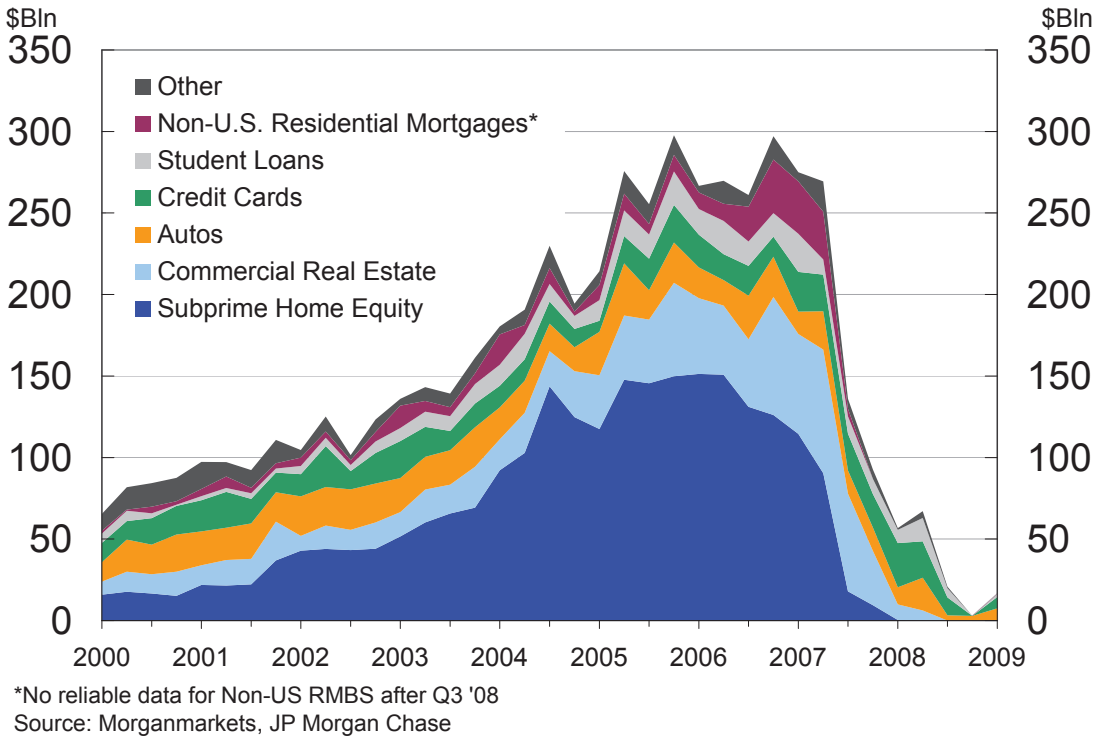
- New issuances of asset-backed securities seem to collapse abruptly
- Collapses associated with fall in collateral values of underlying loans
- Policymakers perceive collapses as associated with increased inefficiency
- Policymakers propose policies intended to remedy increased inefficiency

What We Do

- 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

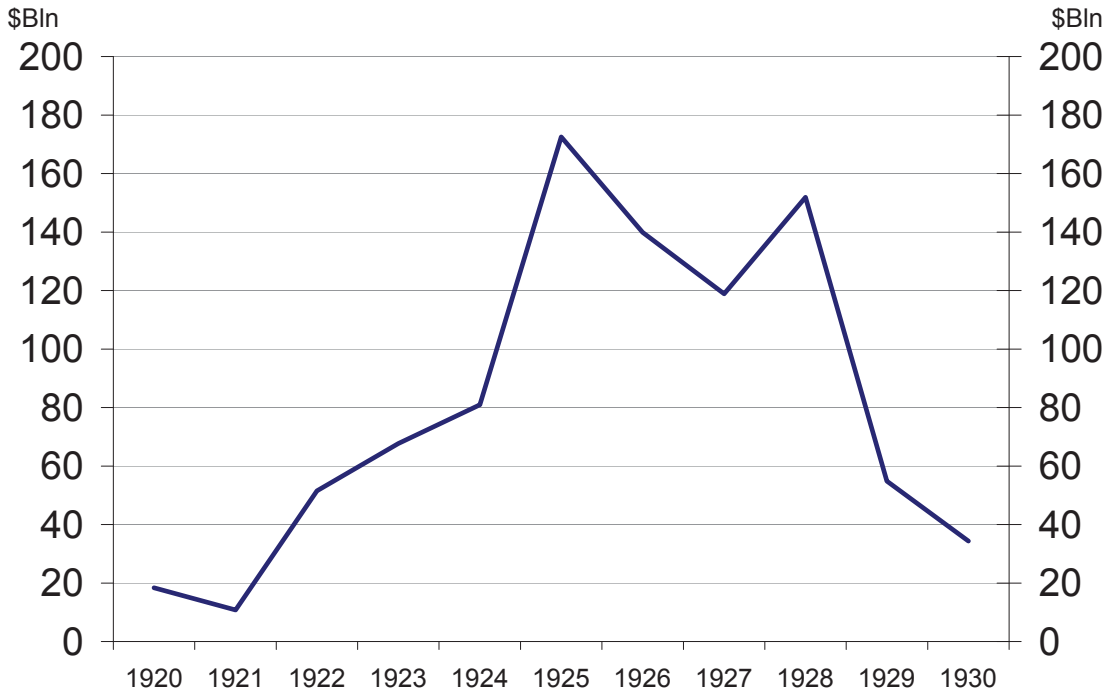
New Issuances of ABSs in 2000s



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

Illustration of Abrupt Collapses

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

- 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

- 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

- 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

- 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

- 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

- 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

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

Securitized Loan Market Model

Environment

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

Bank's Quality Type

- Bank quality type, indexed by loan quality: π
  - Two quality types: $\pi \in \{\underline{\pi}, \bar{\pi}\}, \quad \underline{\pi} < \bar{\pi}$
  - Quality type persistent: same for both periods

- Bank of type π originates a loan with returns:
  - $v = \bar{v}$ with Prob. π
  - $v = \underline{v}$ with Prob. $1 - \pi$

- Initial prior on Bank's type: $\mu_1 = Pr(\pi = \bar{\pi})$

Bank's Cost Type

- Bank's cost of holding loan relative to the market-place:
  - $c \in \{\underline{c}, \bar{c}\}, \quad \underline{c} < 0 < \bar{c}$
  - 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

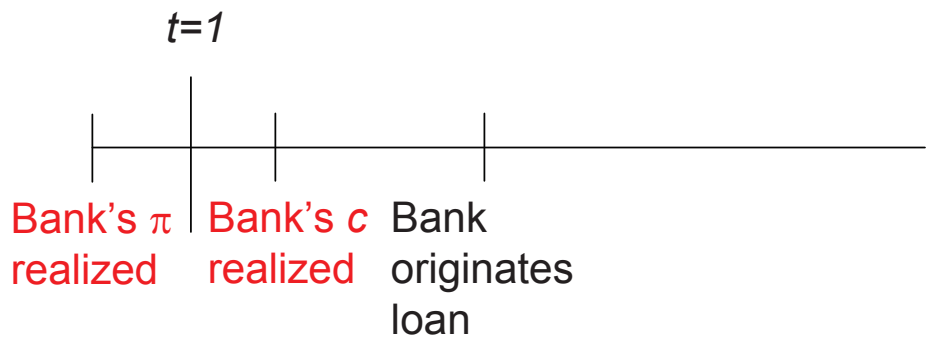
- Bank indexed by quality type and cost type: (π, c)
- Bank types are private information
- After origination, bank chooses to sell or hold loan

Markets

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

Timing

- red: private information



Timing

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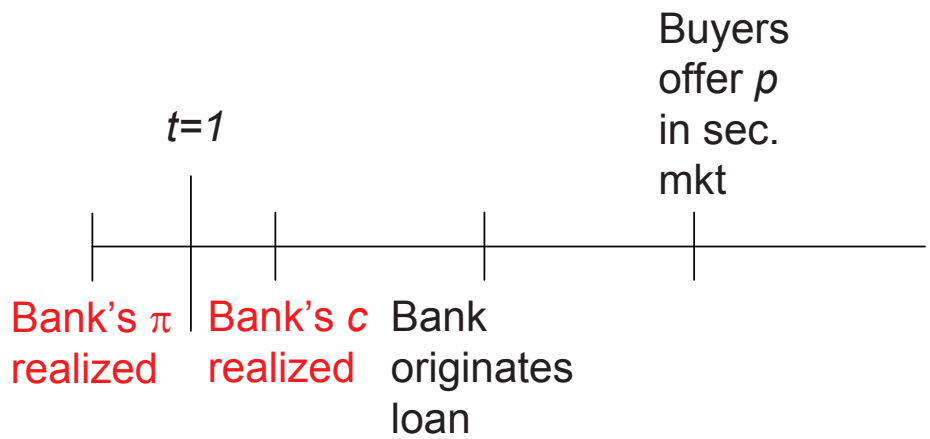

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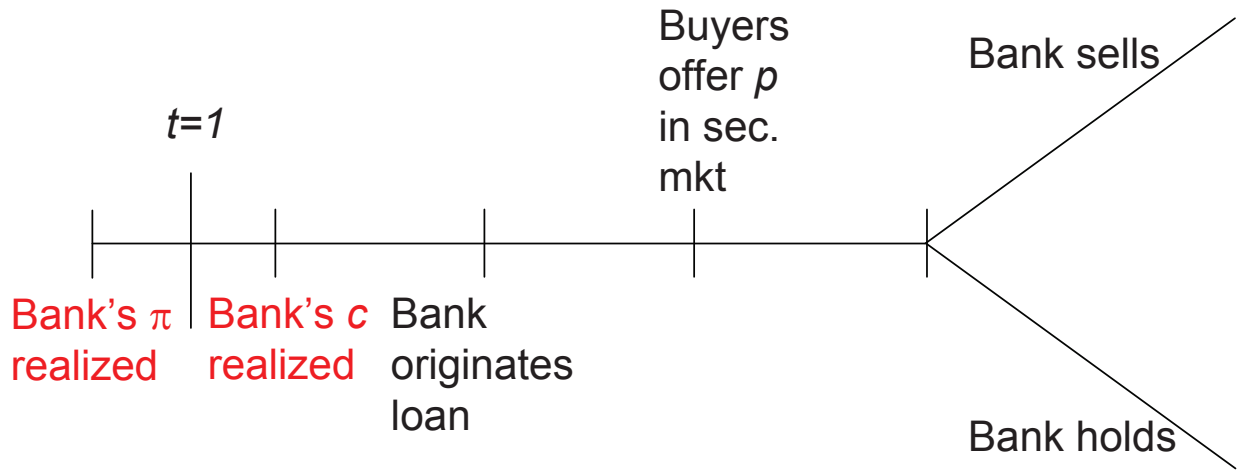

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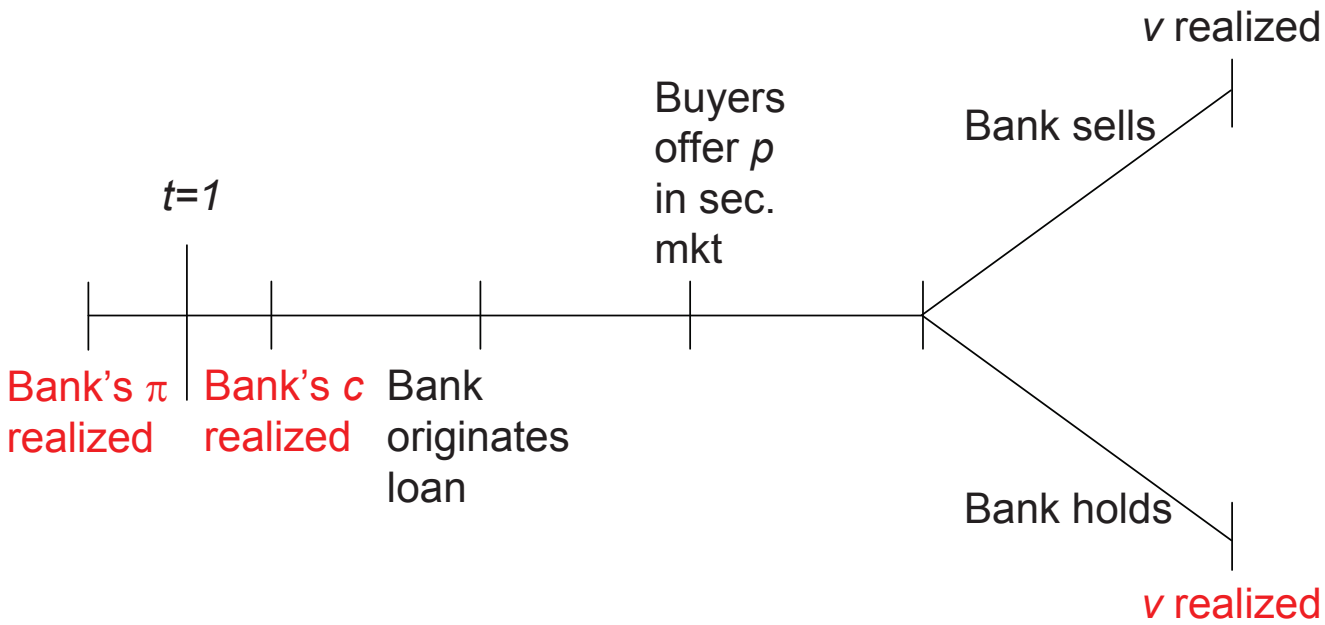

Timing

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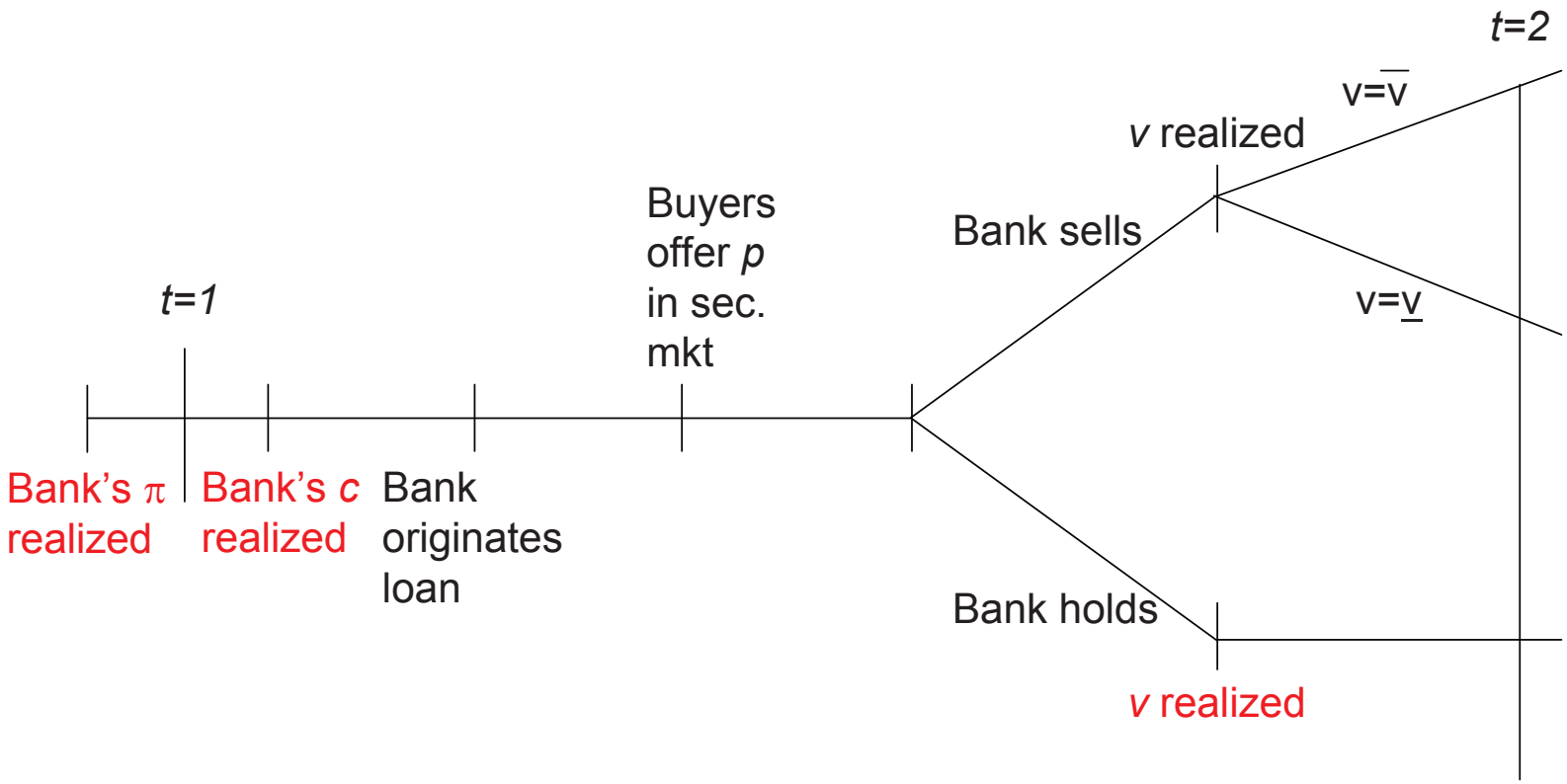


Bank Payoffs

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

$$p$$

  - Hold:

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

Buyer Payoffs

- Buyer payoffs:

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

Equilibrium

- 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 π
- $(\cdot, \underline{c}) \rightarrow$ 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

- 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

- Unique equilibrium which depends on parameter μ_2

  μ_2: reputation in dynamic model

  - If μ_2 is low: Lemons problem
    - Price is low
    - $(\bar{\pi}, \bar{c})$ bank holds loan

  - If μ_2 is high: No lemons problem
    - Price is high
    - $(\bar{\pi}, \bar{c})$ bank sells loan

Break Even Prices

- Two candidate equilibrium prices:

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

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

Static Equilibrium Characterization

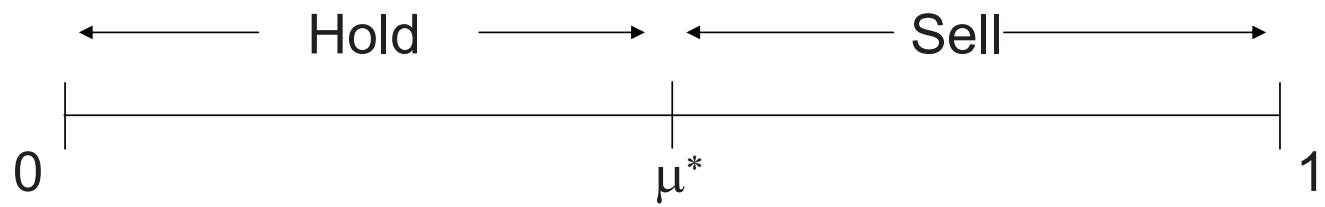
- Selling is an equilibrium if and only if

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

- There exists μ^* 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
- μ^* critical threshold, above which $(\bar{\pi}, \bar{c})$ bank sells in equilibrium

How Equilibrium Depends on Reputation

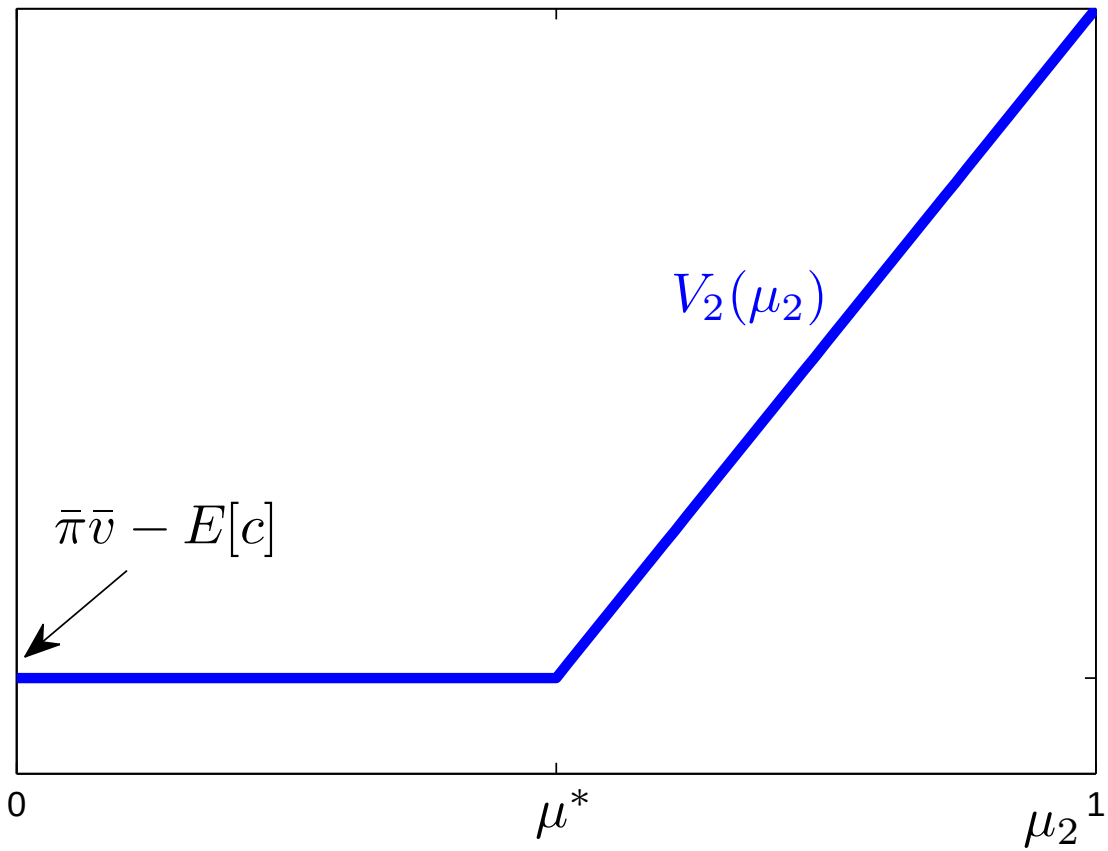
- Last period equilibrium depends only on reputation, μ_2



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

Summarizing Equilibrium

- 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

- 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:

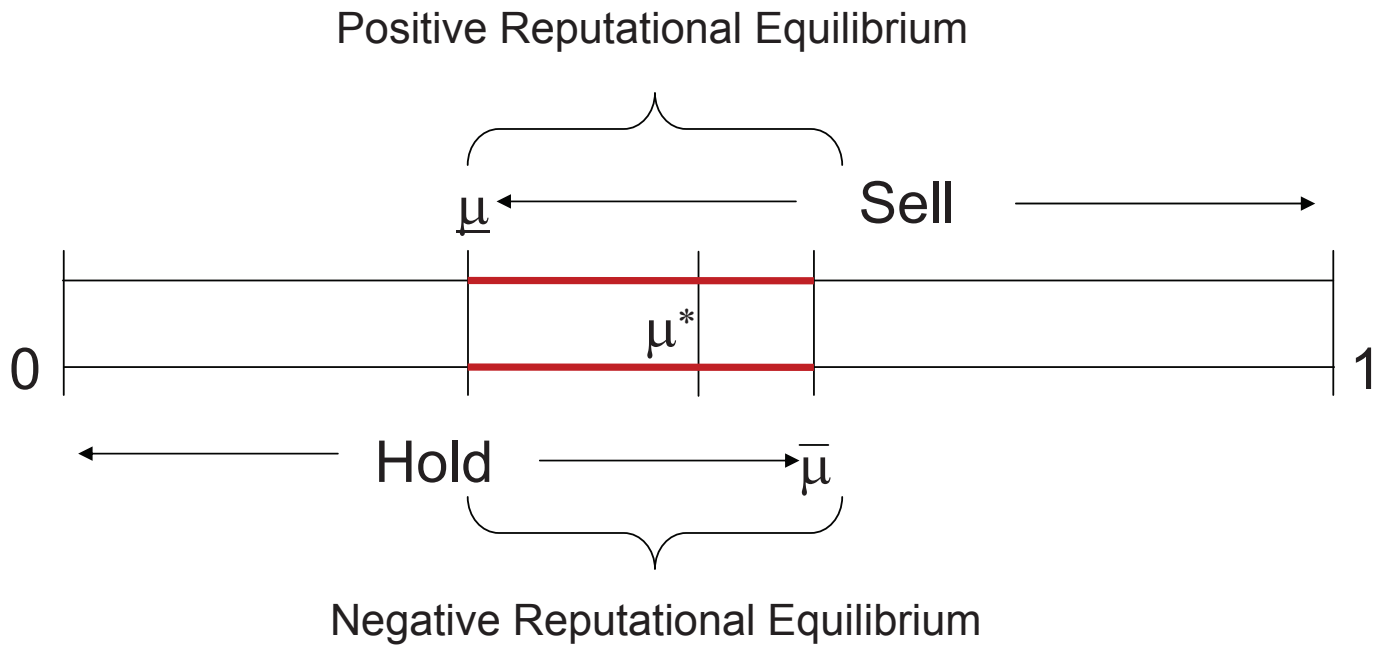
Characterizing Equilibria

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

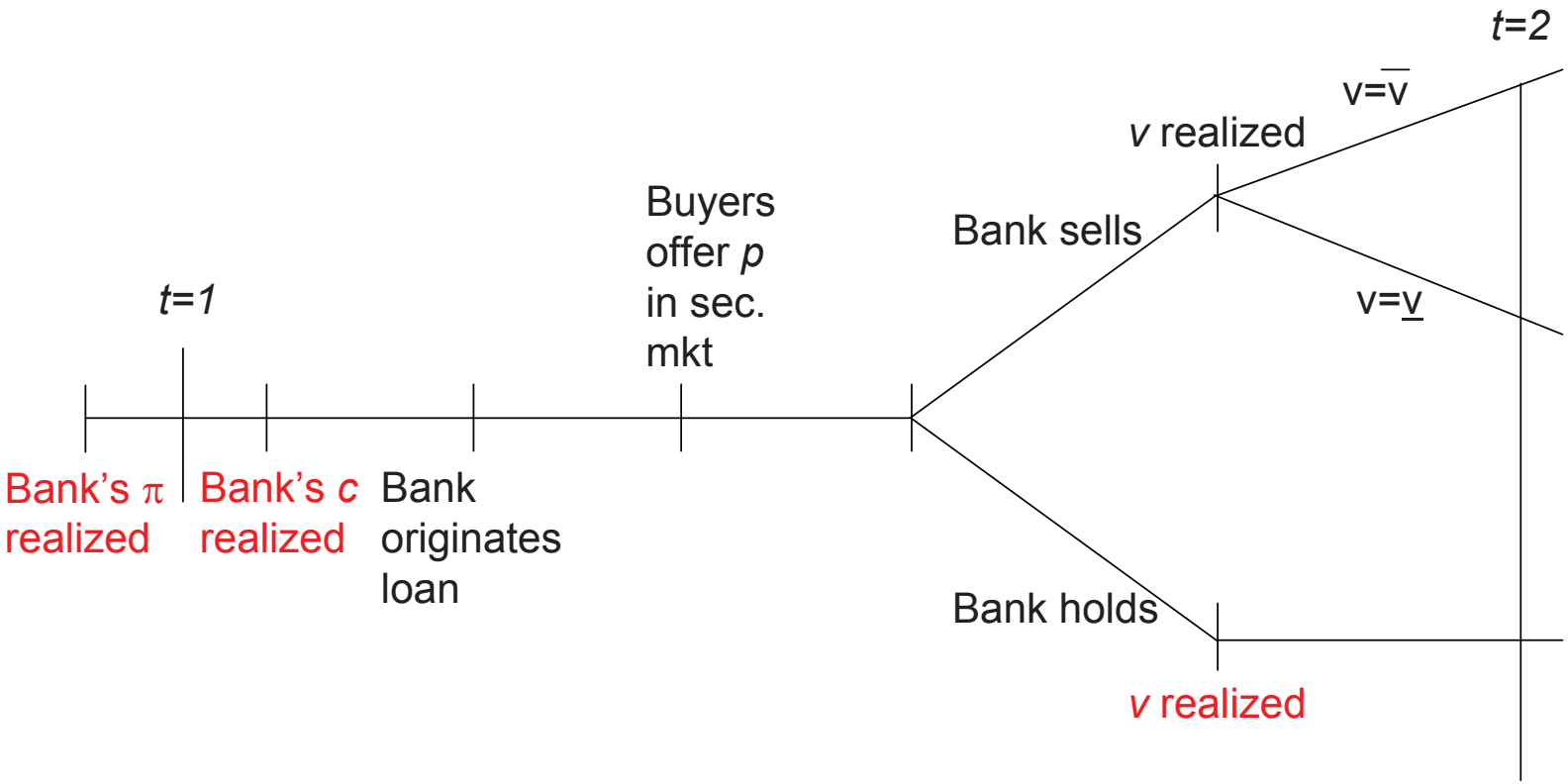
Characterizing Equilibria

- 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



Recall Timing



Bank's Best Response

- 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:

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

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

Updating by Future Buyers

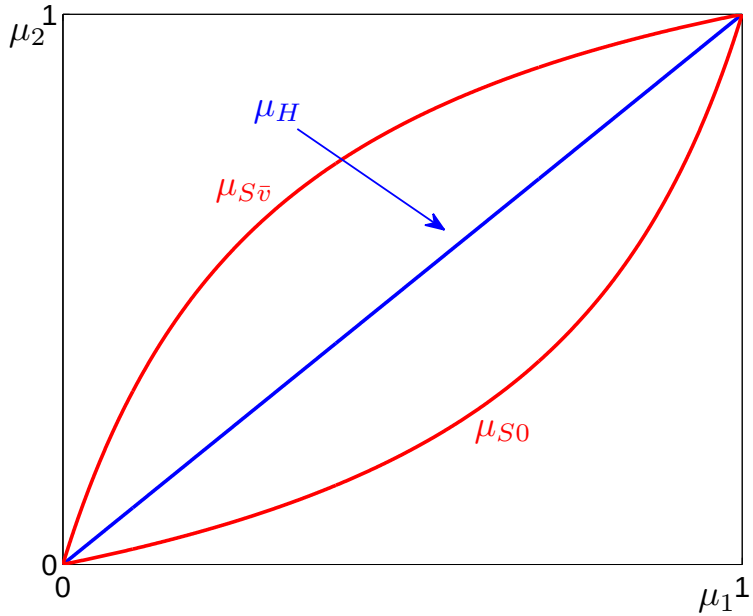
Positive Beliefs:

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

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

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

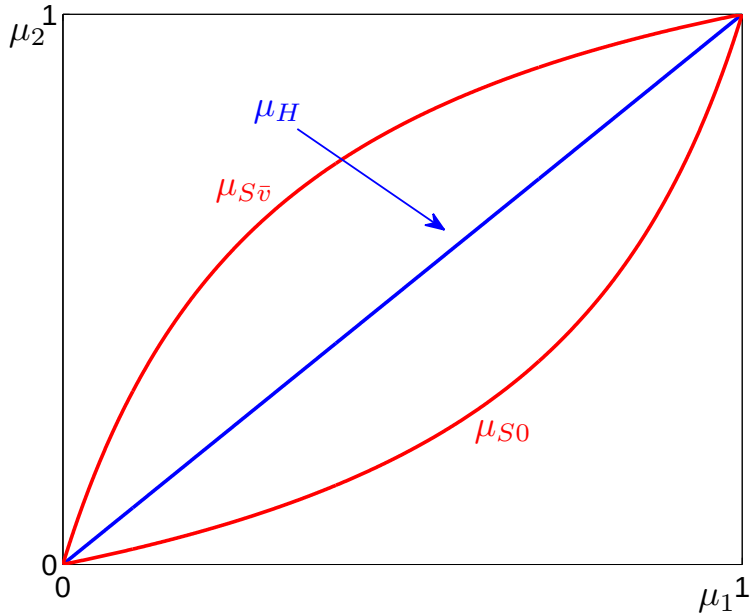
Signal used to update

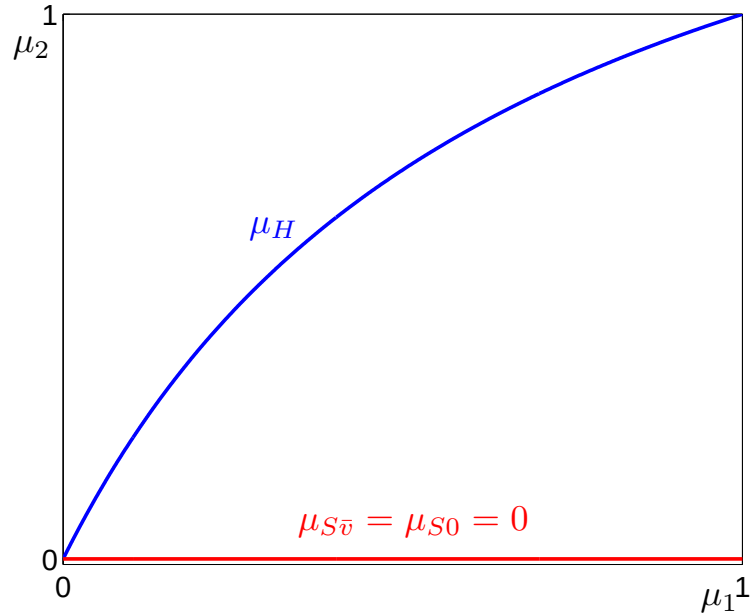


Updating by Future Buyers

Positive Beliefs:
$(\bar{\pi}, \bar{c})$ sells
$(\underline{\pi}, \bar{c})$ sells
$(\cdot, \underline{c})$ holds
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 $(E\mu \geq \mu_1 = \mu_h)$

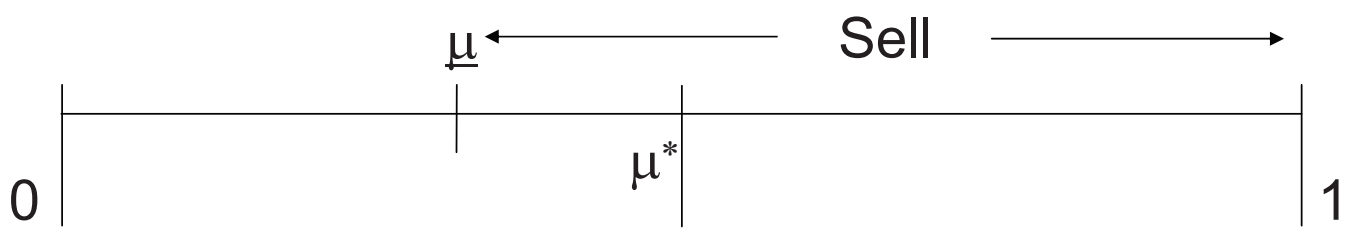
- $(\bar{\pi}, \bar{c})$ banks with reputation below static threshold also sell

Positive Reputational Equilibrium

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 $\mu_1 > \mu^*$,

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

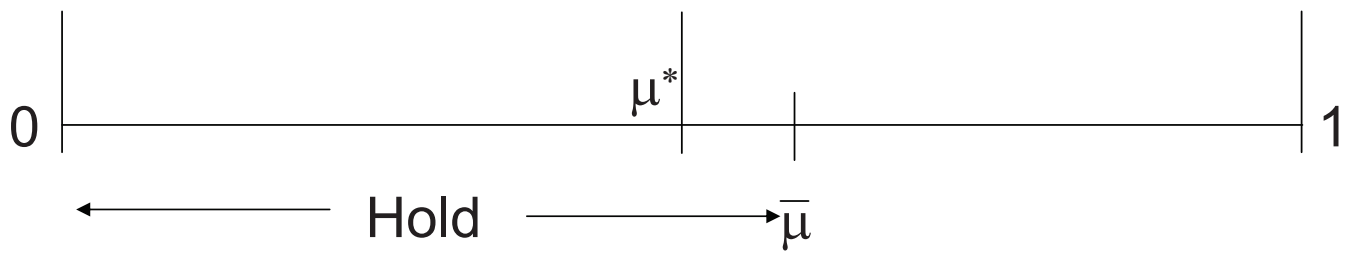
- $(\bar{\pi}, \bar{c})$ banks with reputation above static threshold also hold

Negative Reputational Equilibrium

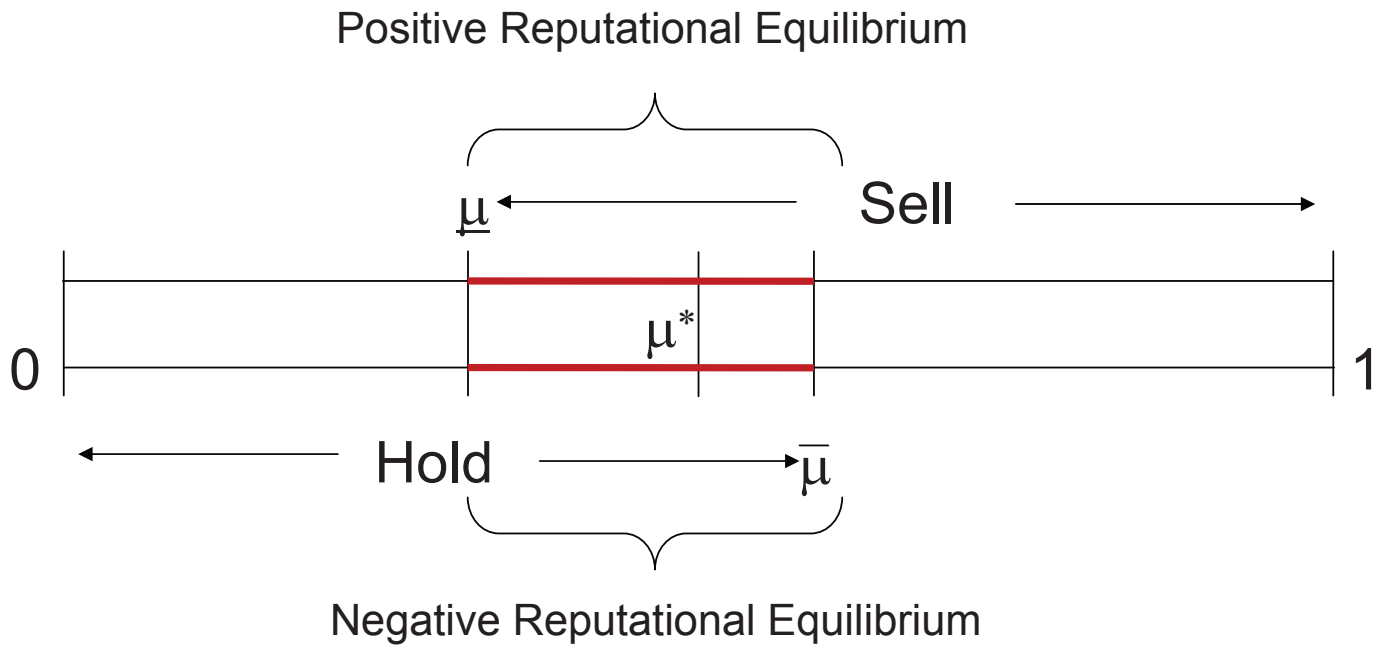
Proposition

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

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



Multiplicity



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

Efficiency

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

Multiplicity

- 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

- 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

- 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 Δv increases

- Raises μ_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

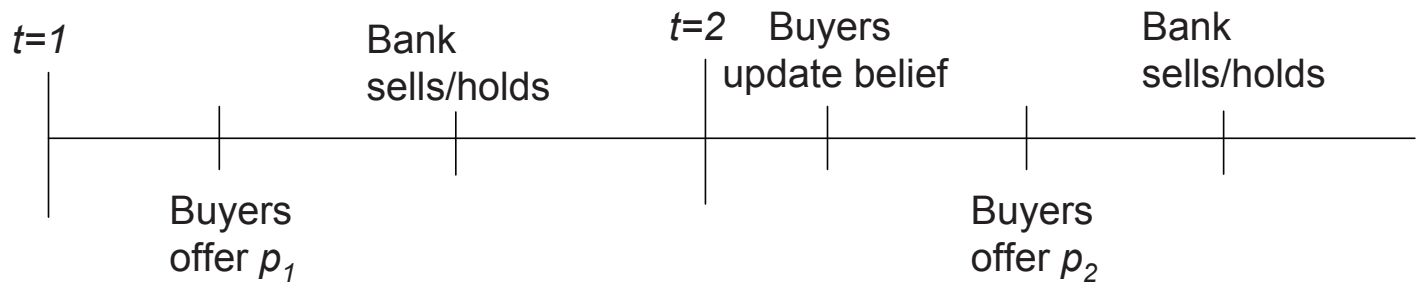
Aggregate Shocks and Perturbation

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

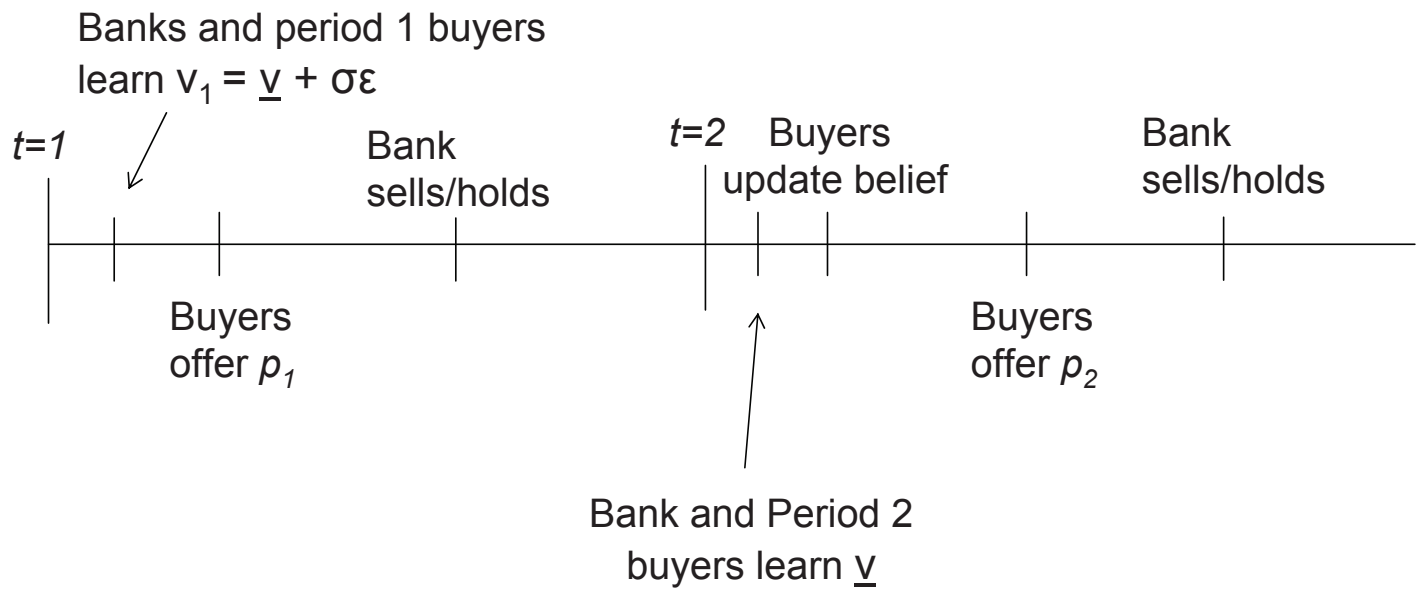
$$v_1 = \underline{v} + \sigma\epsilon, \qquad E\epsilon = 0, \quad E[\underline{v}|v_1] = v_1$$

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

Perturbation



Perturbation



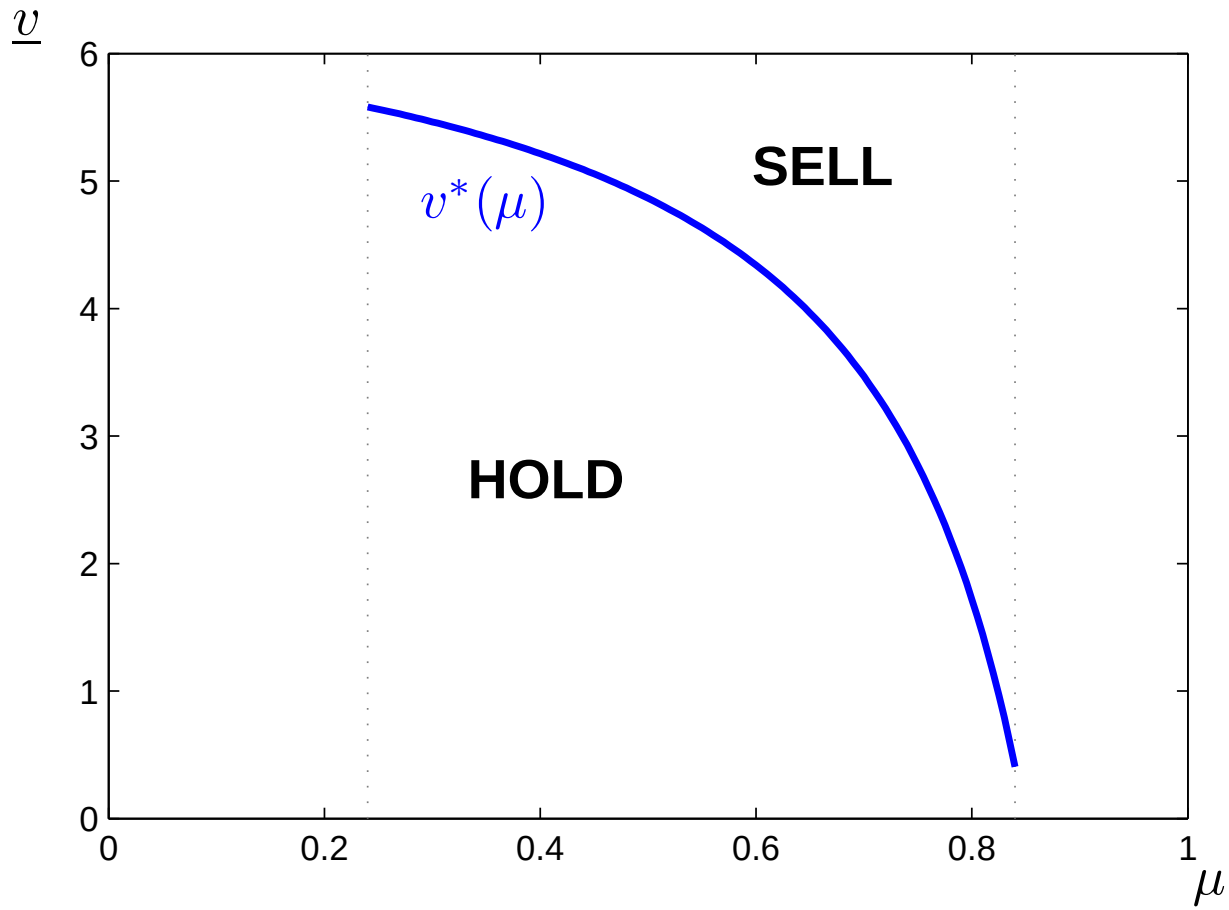
Uniqueness of Equilibrium

Theorem

As $\sigma \to 0$, 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



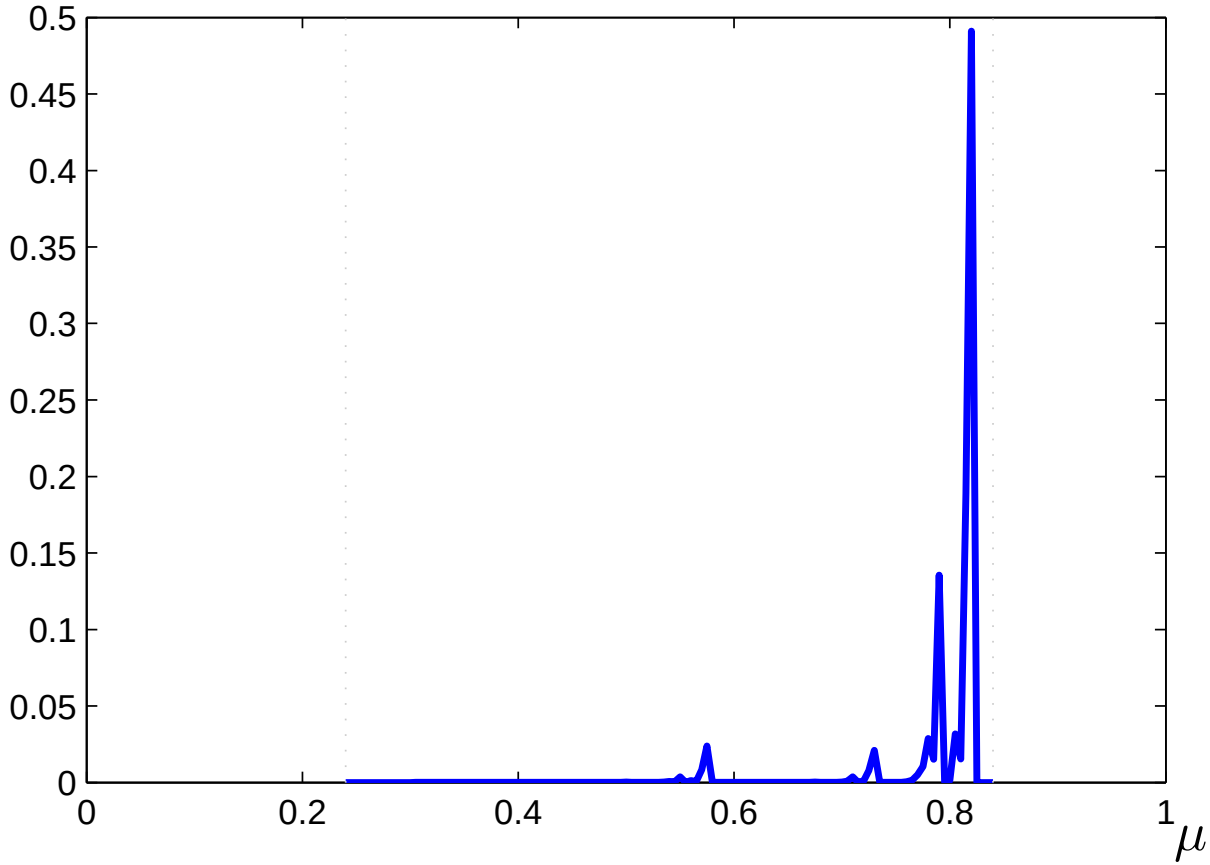
Idea of Proof

- 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

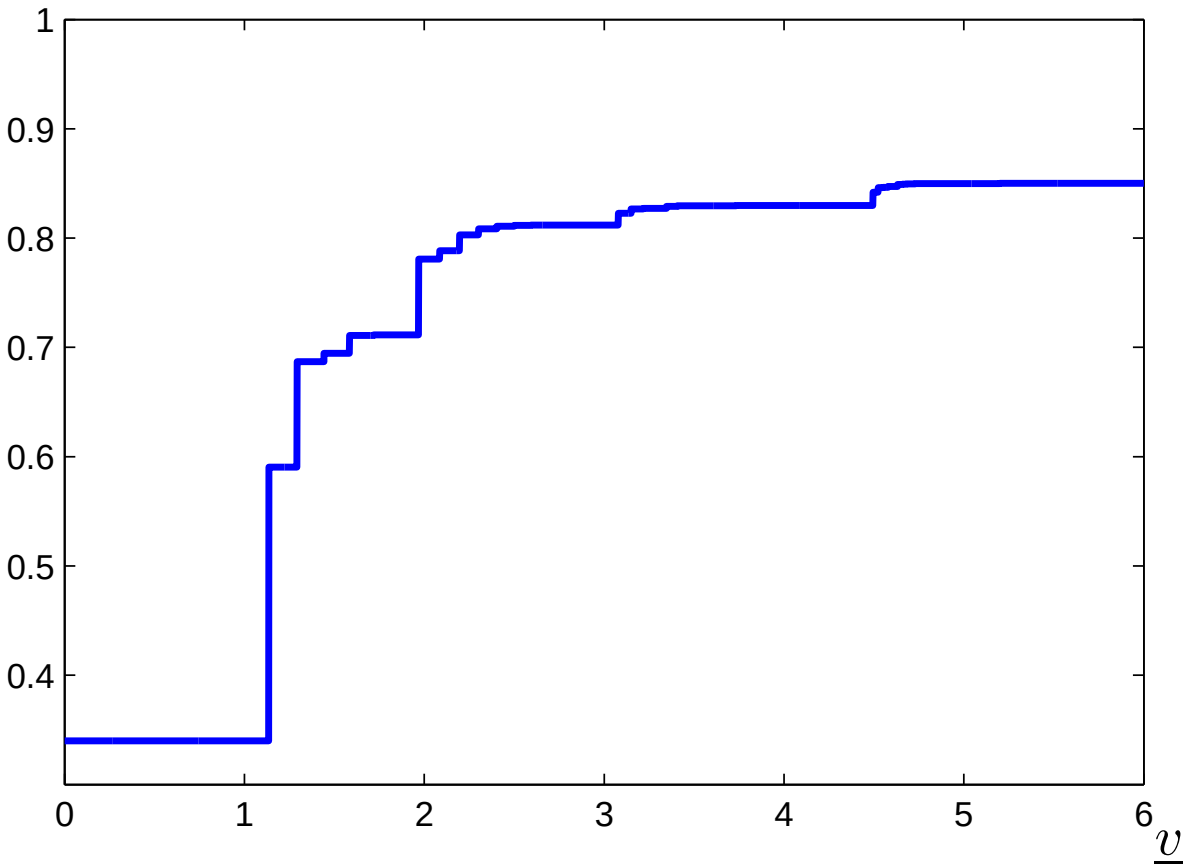
- Limit dominance $\rightarrow$ restrictions on learning
- Restricted learning: tighter bounds on reputational incentives
- Iterating in this manner: Convergence

Invariant Distribution of Reputation



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

Volume of Trade



Sudden Collapses

- 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

- 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

- 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

Policies Subsidizing Debt Finance

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- Worsens lemons problem
- 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

- 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

- Endogenize loan origination
  - What effect does secondary market collapse have on origination?

- Uniquely implement the efficient equilibrium

Conclusions

- 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