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


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Collapse in S.L. Markets
Illustration of Abrupt Collapses

Change in Stock of Real Estate Bonds in 1920s

$Bln$

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

- 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

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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: $\beta$
- Buyers live for one period
Bank’s Quality Type

- Bank quality type, indexed by loan quality: $\pi$
  - Two quality types: $\pi \in \{\pi, \bar{\pi}\}$, $\pi < \bar{\pi}$
  - 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

- 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 indexed by quality type and cost type: \((\pi, c)\)

• 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

$t=1$

- Bank’s $\pi$ realized
- Bank’s $c$ realized
- Bank originates loan

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Timing

- **red**: private information

Bank originates loan

Buyers offer $p$ in sec. mkt

$t=1$

Bank’s $\pi$ realized

Bank’s $c$ realized

Bank originates loan

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Collapse in S.L. Markets
Timing

- **red**: private information

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Bank originates loan
Buyers offer $p$ in sec. mkt
Bank sells
Bank holds

$t=1$

Bank’s $\pi$ realized
Bank’s $c$ realized
Bank originates loan

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Collapse in S.L. Markets
Timing

- **red**: private information
Timing

- **red**: private information

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<table>
<thead>
<tr>
<th>t=1</th>
<th>t=2</th>
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<tbody>
<tr>
<td>Bank's $\pi$ realized</td>
<td>$v$ realized</td>
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<tr>
<td>Bank's $c$ realized</td>
<td>Bank sells</td>
</tr>
<tr>
<td>Bank originates loan</td>
<td>$v=c$</td>
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<td>$v=v$</td>
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Bank Payoffs

- Bank type: \((\pi, c)\)

- Period Payoffs (Normalize \(\bar{y} = 0\) for now)
  - Sell:
    \[
    p
    \]
  - Hold:
    \[
    \pi \bar{v} - c
    \]
Buyer Payoffs

- Buyer payoffs:
  \[ E_{\pi,c} \left[ v \mid (\pi, c) \text{ sells} \right] - p \]
• 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:

\[ \pi \bar{v} \geq \pi \bar{v} - c \]

\[ \Rightarrow \text{sell if and only if } c \geq 0 \]
Full Information Benchmark

- Hold/Sell decision depends only on costs – not on $\pi$
- $(\cdot, c) \rightarrow$ 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
  - $(\cdot, c)$: hold loans
  - $(\bar{\pi}, \bar{c})$: sells loans

- Focus on high quality, high cost bank $(\bar{\pi}, \bar{c})$

- For presentation, fix decisions of remaining banks:
  - $(\cdot, c)$ hold
  - $(\bar{\pi}, \bar{c})$ sell
CHARACTERIZING EQUILIBRIA WITH PRIVATE INFORMATION
LAST PERIOD/STATIC GAME
• 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

- Two candidate equilibrium prices:
  \[(\bar{\pi}, \bar{c}) \text{ bank sells: } p_{sell}(\mu_2) = (\mu_2\bar{\pi} + (1 - \mu_2)\bar{\pi})\bar{v}\]
  \[(\bar{\pi}, \bar{c}) \text{ bank holds: } p_{hold} = \bar{\pi}\bar{v}\]
• 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

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

\[
\bar{\pi} \bar{v} - E[c] \quad V_2(\mu_2)
\]

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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
• 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:
• 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

Positive Reputational Equilibrium

\[ \mu \quad \text{Sell} \]

Negative Reputational Equilibrium

\[ 0 \quad \mu^* \quad \bar{\mu} \quad 1 \]
Recall Timing

$t=1$
- Bank's $\pi$ realized
- Bank's $c$ realized
- Bank originates loan

$t=2$
- Bank holds
- Bank sells
- Buyers offer $p$ in sec. mkt
- $v$ realized

$\bar{v}=v$

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Bank’s Best Response

- Value of Sell:
  
  \[ p + \beta(\pi V_2(\mu_{sv}) + (1 - \pi)V_2(\mu_{s0})) \]

- Value of Hold:
  
  \[ \pi v - c + \beta V_2(\mu_h) \]

- Selling optimal if and only if:
  
  \[ p_{sell}(\mu_1) + \beta [\pi V_2(\mu_{sv}) + (1 - \pi)V_2(\mu_{s0}) - V_2(\mu_h)] \geq \pi v - c \]

  [reputational gain]
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:

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

• Selling optimal if and only if:

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

reputational gain

• \( \mu_{s\bar{v}}, \mu_{s0}, \mu_h \) different in two equilibria
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
\((\pi, c)\) sells
\((\cdot, c)\) holds
Signal used to update

Negative Beliefs:
\((\bar{\pi}, \bar{c})\) holds
\((\pi, c)\) sells
\((\cdot, c)\) holds
Signal ignored in updating

\[ \mu_{S0} = \mu_{S\bar{v}} = 0 \]
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
Proposition

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

- sell for \(\mu_1 \in [\mu, 1]\),
- \(\mu < \mu^*\)
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
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 $\mu_1 \in [\mu, \bar{\mu}]$, 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 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 $v \sim F(v)$

- In static model, $(\bar{\pi}, \bar{c})$ sells if
  \[
  [\mu \bar{\pi} + (1 - \mu)\pi] \bar{v} + [\mu (1 - \bar{\pi}) + (1 - \mu)(1 - \pi)] v \geq \bar{\pi} \bar{v} + (1 - \bar{\pi})v - \bar{c}
  \]

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

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

- Fall in $v$ 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
• $v$ a random variable, $v \sim F(v)$

• Banks and buyers in period 1 observe signal of $v$:

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

• Period 2 buyers do not observe $v_1$ or prices in period 1

• Bank and period 2 buyers observe $u$
Perturbation

$t=1$

Bank sells/holds

Buyers offer $p_1$

$t=2$

Buyers update belief

Bank sells/holds

Buyers offer $p_2$
Banks and period 1 buyers learn \( v_1 = v + \sigma \varepsilon \)

\[ t=1 \quad \text{Bank sells/holds} \]

Buyers offer \( p_1 \)

\[ t=2 \quad \text{Buyers update belief} \]

Bank sells/holds

Buyers offer \( p_2 \)

Bank and Period 2 buyers learn \( v \)
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

\[
v^*(\mu)
\]

\(\mu\)

SELL

HOLD

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Idea of Proof

- Reputational incentives depend on future buyer’s belief about \((\pi, \bar{c})\) bank’s action in 1st period

- Reputational incentives are bounded

- Dominance regions:
  - Very high \(v_1\): \((\pi, \bar{c})\) bank sells independent of future beliefs
  - Very low \(v_1\): \((\pi, \bar{c})\) 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 $\bar{\tau}$ banks (with exogenous replacement)
Volume of Trade

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

- Government reduces interest rates in period 1
- Greater incentives to hold rather than sell
- 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
• 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