Strategic Opaqueness: A Cautionary Tale on Securitization

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July 2015
Motivation

- Enormous rise in securitization in the banking sector
- Increase in banks’ interconnectedness
  - Overlapping portfolios
  - Interbank exposures
- Run on banks
  - Information asymmetry
Research Questions

- *Why* do banks securitize their assets?
Research Questions

- Why do banks securitize their assets?
- How much do they choose to securitize?
Our framework:

- **Banks**
  - Issue debt to invest in risky projects
  - Can securitize their assets

- **Investors**
  - Have access only to local information about the state of the project
  - Decide whether to liquidate prematurely or continue
Why do banks securitize their assets?

- Securitization creates information asymmetry
- Traditionally: information asymmetry leads to securitization

Securitization is welfare reducing and leads to banking crisis

Bailouts further increase probability of banking crisis
Why do banks securitize their assets?

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How much do they choose to securitize?

- Optimal portfolio: optimal opaqueness
- Securitization is welfare reducing and leads to banking crisis
Why do banks securitize their assets?
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How much do they choose to securitize?
- Optimal portfolio: *optimal* opaqueness
- Securitization is welfare reducing and leads to banking crisis

Bailouts further increase probability of banking crisis
Outline

Model

Equilibrium

Welfare, optimal securitization and financial crises

Conclusion
The Model

The environment

- Three dates \( t = 0, 1, 2 \)
- Two banks \( i = 1, 2 \)
- Two investors \( I = 1, 2 \)
The Model

The environment

- Three dates $t = 0, 1, 2$
- Two banks $i = 1, 2$
- Two investors $I = 1, 2$
- Bank $i$ raises one unit of funds from investor $I$:
  - Issues debt contracts at face value $D$ with maturity at date $t = 2$
  - Invests in a risky project that returns $\tilde{R}_i$ per unit of investment at date $t = 2$

<table>
<thead>
<tr>
<th>State</th>
<th>Probability</th>
<th>Return $t = 2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\theta_i = L$</td>
<td>$p_L$</td>
<td>0</td>
</tr>
<tr>
<td>$\theta_i = M$</td>
<td>$p_M$</td>
<td>$R_M$</td>
</tr>
<tr>
<td>$\theta_i = H$</td>
<td>$p_H$</td>
<td>$F_H(.) = R_H$</td>
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$R_H > R_M > 0$
At date 0, banks choose whether to securitize a fraction of their project

- Bank $i$, chosen at random, proposes to exchange a fraction $(1 - \phi)$ of her project for a fraction $(1 - \phi)$ of bank $j$’s project
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- Bank $i$, chosen at random, proposes to exchange a fraction $(1 - \phi)$ of her project for a fraction $(1 - \phi)$ of bank $j$’s project
- Bank $j$ can accept or reject
  - If she reject, no exchange takes place
  - If she accepts, bank $i$’s portfolio is
    \[
    V_i(\phi) = \phi \tilde{R}_i + (1 - \phi) \tilde{R}_j
    \]
    while bank $j$’s portfolio is
    \[
    V_j(\phi) = \phi \tilde{R}_j + (1 - \phi) \tilde{R}_i
    \]
At date 1, perfectly revealing signal $\theta_i \in \{L, M, H\}$ is realized about state of project $i$

- Investor $I$ observes signal $\theta_i$
- Bank $i$ observes both signals $\theta_i$ and $\theta_j$ if $\phi \in (0, 1)$
At date 1, after observing $\theta_i$, investor $I$ chooses to liquidate or continue

$$s_I(\theta_i) = \begin{cases} 
1 & \text{if investor } I \text{ continues bank } i \\
0 & \text{if investor } I \text{ liquidates bank } i 
\end{cases}$$
The Model

Actions and payoffs

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- **Liquidate**
  - Investor receives an early liquidation value, $r < R_M$.
  - Bank receives 0
The Model
Actions and payoffs

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$$s_I(\theta_i) = \begin{cases} 
1 & \text{if investor } I \text{ continues bank } i \\
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\end{cases}$$

- **Liquidity**
  - Investor receives an early liquidation value, $r < R_M$.
  - Bank receives 0

- **Continue**
  - Investor receives $D$ at date 2, if $V_i \geq D$ and zero otherwise
  - Bank is the residual claimant and receives at date 2
    \[\max\{V_i - D, 0\}\]
  - Note: if $V_i < D$, bankruptcy wipes out $V_i$ and both the bank and the investor receive 0.
The Model

Timing

- Date 0:
  - Banks borrow from investors and invest in projects
  - Banks choose their portfolio \((\phi, 1 - \phi)\)
  - Face value of debt \(D\) set to maximize expected lender surplus
The Model

Timing

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  - Signals are realized
  - Investors decide whether to continue or liquidate
The Model
Timing

- **Date 0:**
  - Banks borrow from investors and invest in projects
  - Banks choose their portfolio \((\phi, 1 - \phi)\)
  - Face value of debt \(D\) set to **maximize expected lender surplus**

- **Date 1**
  - Signals are realized
  - Investors decide whether to continue or liquidate

- **Date 2, for the bank(s) continued**
  - The project(s) matures
  - The debt is paid back, or the bank is destroyed
Outline

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Equilibrium

A symmetric equilibrium is given by

- A portfolio allocation \((\phi^*, 1 - \phi^*)\) and a face value of debt \(D^*\)
- A continuation decision \(s^*_i(\theta_i)\) of each investor \(I\) given signal \(\theta_i\)

such that
Equilibrium

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such that

- Investor \(I\)'s decision is optimal:
  - Each investor \(I\)'s expected payoff is maximized at date 1
    \[
    \max_{s_I} \{ s_I(\theta_i) \cdot D^* \cdot \Pr(D^* \leq V_i(\phi^*) | \theta_i) + (1 - s_I(\theta_i)) \cdot r \}
    \]
  - Face value of debt maximizes investors expected surplus at date 0
    \[
    \max_D \mathbb{E}_{\theta_i} \{ s^*_I(\theta_i) \cdot D \cdot \Pr(D \leq V_i(\phi^*) | \theta_i) + (1 - s^*_I(\theta_i)) \cdot r \}
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A symmetric equilibrium is given by

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    \max_D \mathbb{E}_{\theta_i} \{ s_i^* (\theta_i) \cdot D \cdot \Pr(D \leq V_i(\phi^*) | \theta_i) + (1 - s_i^* (\theta_i)) \cdot r \}
    \]
- Bank \(i\)'s decision is optimal:
  - Portfolio allocation maximizes bank' expected surplus at date 0
    \[
    \max_{\phi} \mathbb{E}_{\theta_i, \theta_j} \{ \max[(V_i(\phi) - D^*), 0] | s_i^* (\theta_i) \}
    \]
Equilibrium

2 Steps

1. Solve for investors’ optimal decisions, given $\phi$.

2. Solve for banks’ optimal decisions.
Investors’ Decisions

Face value of debt

Given a continuation decision \( s_i (\theta_i) \), the face value of debt is

\[
D^*_i = \arg \max \mathbb{E}_{\theta_i} \{ s_i^* (\theta_i) \cdot D \cdot \Pr(D \leq V_i (\phi^*) | \theta_i) + (1 - s_i^* (\theta_i)) \cdot r \}
\]
Example 1: $\phi = 1$.

$\triangleright$ $s_I(H) = 1$, and $s_I(M) = s_I(L) = 0$

$$D^*_H = \text{arg max} \left[ p_H \cdot D \cdot \Pr(D \leq \tilde{R}_i | \theta_i = H) \right]$$

$$= R_H.$$  

$\triangleright$ $s_I(H) = s_I(M) = 1$, and $s_I(L) = 0$

$$D^*_{HM} = \text{arg max} \left[ p_H \cdot D \cdot \Pr(D \leq \tilde{R}_i | \theta_i = H) + p_M \cdot D \cdot \Pr(D \leq \tilde{R}_i | \theta_i = M) \right]$$

$$= R_M.$$
Investors’ Decisions

Face value of debt

Example 1: $\phi = 1$.

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$$D^*_{HM} = \arg \max \left[ p_H \cdot D \cdot \Pr (D \leq \tilde{R}_i | \theta_i = H) + p_M \cdot D \cdot \Pr (D \leq \tilde{R}_i | \theta_i = M) \right]$$

$$= R_M.$$

Example 2: $\hat{\phi} = \frac{R_M}{\frac{R_H}{p_H + p_M} - (R_H - R_M)}$.

$\blacktriangleright$ $s_I(H) = 1$, and $s_I(M) = s_I(L) = 0$

$$D^*_H = \arg \max \left[ p_H \cdot D \cdot \Pr (D \leq (\phi \tilde{R}_i + (1 - \phi) \tilde{R}_j) | \theta_i = H) \right]$$

$$= \phi R_H,$$

$\blacktriangleright$ $s_I(H) = s_I(M) = 1$, and $s_I(L) = 0$

$$D^*_{HM} = R_M.$$
Investors’ Decisions

Face value of debt

\[ D^*_{s} I \]

\[ D^*_{H} \]
Investors’ Decisions

Face value of debt

The graph shows the relationship between $D_{SI}^*$ and $\phi$, with two lines denoted by $D_H^*$ and $D_{HM}^*$. The graph indicates how the face value of debt changes with respect to $\phi$. The x-axis represents $\phi$ ranging from 0 to 1, and the y-axis represents $D_{SI}^*$ ranging from 2.5 to 7.
Investors’ Decisions

Face value of debt
Investors’ Decisions

Investors’ surplus

Given a continuation decision $s_l(\theta_i)$ and $D^*_{s_l}$, then investor $I$’s surplus is

\[
\begin{align*}
D^*_{s_l} \cdot \Pr(D^*_{s_l} \leq V_i(\phi) | \theta_i = H) \cdot s_l(H) + r \cdot (1 - s_l(H)) \quad & \text{with prob } p_H \\
D^*_{s_l} \cdot \Pr(D^*_{s_l} \leq V_i(\phi) | \theta_i = M) \cdot s_l(M) + r \cdot (1 - s_l(M)) \quad & \text{with prob } p_M \\
D^*_{s_l} \cdot \Pr(D^*_{s_l} \leq V_i(\phi) | \theta_i = L) \cdot s_l(L) + r \cdot (1 - s_l(L)) \quad & \text{with prob } p_L
\end{align*}
\]
Investors’ Decisions

Example 1 (cont): \( \phi = 1. \)

- \( s_I(H) = 1, \text{ and } s_I(M) = s_I(L) = 0 \)
  \[ p_H \cdot R_H + (p_M + p_L) \cdot r \]

- \( s_I(H) = s_I(M) = 1, \text{ and } s_I(L) = 0 \)
  \[ (p_H + p_M) \cdot R_M + p_L \cdot r \]

Example 2 (cont): \( \hat{\phi} = \frac{R_M}{R_H - (R_H - R_M)} \cdot \frac{R_H}{p_H + p_M}. \)

- \( s_I(H) = 1, \text{ and } s_I(M) = s_I(L) = 0 \)
  \[ p_H \cdot \hat{\phi}R_H + (p_M + p_L) \cdot r \]

- \( s_I(H) = s_I(M) = 1, \text{ and } s_I(L) = 0 \)
  \[ p_H \cdot (p_H + p_M) \cdot R_M + p_M \cdot (p_H + p_M) \cdot R_M + p_L \cdot r \]
Investors’ Decisions

Investors’ surplus

![Graph showing the relationship between investor surplus and \(\phi\). The graph illustrates the function \(IS_H^*\) indicating how investor surplus changes with respect to \(\phi\).]
Investors’ Decisions

Investors’ surplus

\[ IS^*_{H} \]

\[ IS^*_{HM} \]
Investors’ Decisions

Investors’ surplus

\[ \text{Investor Surplus} \]

\[ IS^* \]

\[ IS^*_{HM} \]

\[ IS^*_{HML} \]

\[ \phi \]
Investors’ Decisions

Continuation decision

\[ \text{Investor Surplus} \]

\[ IS^* \]

\[ H \]

\[ IS^*_{HM} \]

\[ IS^*_{HML} \]

\[ IS_{Optimal} \]
Intuition: for each $\phi$, the investor chooses over compound lotteries

- The inner lotteries: the choice of $D$ for each continuation decision
  - Small $D$ is a safe lottery;
  - High $D$ is a risky lottery.
Intuition: for each $\phi$, the investor chooses over compound lotteries

- The inner lotteries: the choice of $D$ for each continuation decision
  - Small $D$ is a safe lottery;
  - High $D$ is a risky lottery.
- The outer lotteries: the continuation decision
  - Continuation in $H&M$: smaller expected payoffs in each state;
  - Continuation in $H$: higher expected payoff in state $H$, but only $r$ in state $M$. 
Given a continuation decision $s_l(\theta_i)$, then bank $i$’s surplus

$$
\begin{align*}
\mathbb{E}_{\theta_j}\{\max[(\phi_{s_l} R_H + (1 - \phi_{s_l}) \tilde{R}_j - D^*_{s_l}), 0]\} \cdot s_l(H) \quad &\text{with prob } p_H \\
\mathbb{E}_{\theta_j}\{\max[(\phi_{s_l} R_M + (1 - \phi_{s_l}) \tilde{R}_j - D^*_{s_l}), 0]\} \cdot s_l(M) \quad &\text{with prob } p_M \\
\mathbb{E}_{\theta_j}\{\max[(0 + (1 - \phi_{s_l}) \tilde{R}_j - D^*_{s_l}), 0]\} \cdot s_l(L) \quad &\text{with prob } p_L
\end{align*}
$$
Example 1 (cont): $\phi = 1$

- If $(p_H + p_M) R_M > p_H R_H + p_M r$
  
  $s^*_I (H) = s^*_I (M) = 1$, $s^*_I (L) = 0$, and $D^* = R_M$.

  $$p_H (R_H - R_M).$$

Example 2 (cont): $\hat{\phi} = \frac{R_M}{R_H - (R_H - R_M)}.$

- If $\phi p_H R_H + p_M r > (p_H + p_M)^2 R_M$
  
  $s^*_I (H) = 1$, $s^*_I (M) = s^*_I (L) = 0$, and $D^* = \phi R_H$

  $$p_H \cdot (1 - \phi) (p_H R_H + p_M R_M)$$
Banks’ Decisions

Banks surplus

\[ \phi \]

Borrower Surplus

\[ BS_H^* \]
**Banks’ Decisions**

Banks surplus

![Graph showing Borrower Surplus (BS*) vs. \( \phi \)](image)

- **BS**
  - \( BS_{H}^{*} \)
  - \( BS_{HM}^{*} \)
Banks’ Decisions

Banks surplus

\[ \frac{B \phi^* H}{B H^{**}} \]

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\[ \frac{B \phi^* H}{B H^{**}} \]
Banks’ Decisions

Optimal securitization

\[
\phi
\]

Borrower Surplus

\[BS^*_H, BS^*_HM, BS^*_HML\]

Optimal

\[H, HM, HML\]
Outline

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Proposition 1

Securitization decreases welfare.

Note: Welfare = Investors’ + Banks’ surplus
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- Ineffective liquidation and continuation
  - Lender cannot effectively liquidate bad projects
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  - (Potential) countervailing force: downward adjustment in face value by investor → not enough
Welfare

Proposition 1

Securitization decreases welfare.

Note: Welfare = Investors’ + Banks’ surplus

- Ineffective liquidation and continuation
  - Lender cannot effectively liquidate bad projects
  - (Potential) countervailing force: downward adjustment in face value by investor → not enough

- Too-frequent liquidation
  - With perfect info, the investor is able to set a face value he obtains with high probability if his bank is in state $H$ or $M$.
  - With less info, he cannot do that: he obtains the same face value with lower probability when his bank is in state $M$, or $H$.
  - Liquidate more often to break the tie: choose the riskier lottery
Welfare

![Graph showing the relationship between Total Surplus (TS) and a variable labeled as \( \phi \).](image-url)

- The y-axis represents Total Surplus, ranging from 0 to 5.5.
- The x-axis represents the variable \( \phi \), ranging from 0 to 1.
- The graph illustrates the behavior of Total Surplus as \( \phi \) changes, showing distinct steps or jumps in the surplus value.
Proposition 2

The banks always have an incentive to securitize and set $\phi \in (0, 1)$.

Intuition: division of the surplus favors the bank
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Intuition: division of the surplus favors the bank

- Full securitization ($\phi = 0$) and no securitization ($\phi = 1$) are identical: the bank obtains surplus $(R_H - R_M)$ only in state $H$;
- Total surplus decreases when $\phi < 1$, but the share of investors’ decreases more.
Proposition 2

The banks always have an incentive to securitize and set $\phi \in (0, 1)$.

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- Total surplus decreases when $\phi < 1$, but the share of investors' decreases more.
- Compound lottery
  - Conditional on signal: dispersion
  - Revision in face value of debt
Optimal Securitization

Division of Surplus over $\phi$:
- $T_S$
- $LS$
- $BS$

Legend:
- $T_S$
- $LS$
- $BS$
Proposition 3

*There exist equilibria in which securitization increases the probability of financial crises.*

Intuition: the bank chooses over a continuum of compound lotteries to offer the investor (one for each $\phi$)
Proposition 3

There exist equilibria in which securitization increases the probability of financial crises.

Intuition: the bank chooses over a continuum of compound lotteries to offer the investor (one for each $\phi$)

- Each compound lottery translates to two outcomes for the bank:
  - Continued in both state $H$ and $M$, but with smaller expected payoffs;
  - Continued in state $H$, with higher expected payoff in state $H$ (because of lower $D^*$), but only 0 in state $M$ and $L$. 
**Proposition 3**

*There exist equilibria in which securitization increases the probability of financial crises.*

Intuition: the bank chooses over a continuum of compound lotteries to offer the investor (one for each $\phi$)

- Each compound lottery translates to two outcomes for the bank:
  - Continued in both state $H$ and $M$, but with smaller expected payoffs;
  - Continued in state $H$, with higher expected payoff in state $H$ (because of lower $D^*$), but only 0 in state $M$ and $L$.

- Banks solves a max-min problem
  - *Twist*: total surplus is also affected
Outline

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Conclusion
Conclusions

- Model of optimal choice of securitization
- Securitization determines surplus division between investors and banks
- Banks securitize to maximize their share
- *Excessive runs*
  - Lenders *act* on their information more aggressively
  - Bank *chooses* to be run on
Related Literature

- Gorton and Pennacchi (1990)
- DeMarzo (2005), Duffie (2008)
- Stanton, Walden, Wallace (2014)