Securitization, Ratings, and Credit Supply

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Motivation

Securitization has been an important driver of economic activity.

- More generally, the ability to originate assets whose cash flow rights can later be sold to investors
- Inherent trade-off: incentives vs efficient allocation

The securitization process has come under intense scrutiny since the financial crisis...

- Dodd Frank imposed a number of regulations on both issuers of ABS and the agencies that rate them.
    - mandatory "skin in the game"
    - disclosure requirements on rating agencies

On mandatory "skin in the game"

"When properly structured, securitization provides economic benefits that lower the cost of credit to households and businesses. However, when incentives are not properly aligned and there is a lack of discipline in the origination process, securitization can result in harm to investors, consumers, financial institutions, and the financial system. During the financial crisis, securitization displayed significant vulnerabilities to informational and incentive problems among various parties involved in the process"

"By requiring that the securitizer retain a portion of the credit risk of the assets being securitized, section 15G provides securitizers an incentive to monitor and ensure the quality of the assets underlying a securitization transaction, and thereby helps align the interests of the securitizer with the interests of investors."

–Section 15G, Dodd Frank

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–Section 15G, Dodd Frank

On mandatory "skin in the game"

"The Proposal will impose new, and in some cases onerous, requirements on ABS sponsors and we are very concerned that if adopted in its current form, the Proposal will significantly and negatively impact the viability of an effective securitization market and the availability of consumer and corporate credit."

–Letter from JP Morgan Chase in response to Proposal

Motivation

An old idea: endogenous skin in the game can serve as a “signal” of quality (Leland and Pyle, 1977).

- If you make good loans, you retain more of them
- By doing so, what you sell goes for a higher price
- This provides (at least) some incentive to make good loans in the first place

But...

- How well does the signaling mechanism balance the trade-off?
- What about other ways investors can learn about the quality of loans underlying a security?

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On rating agency regulation

"By imposing structural, regulatory, and liability reforms on rating agencies, this agreement will change the way nationally recognized statistical rating organizations behave and ensure that they effectively perform their functions as market gatekeepers going forward."

–Congressman Paul Kanjorski

"We find no evidence that Dodd-Frank disciplines CRAs to provide more accurate and informative credit ratings. Instead, following Dodd-Frank, CRAs issue lower ratings, give more false warnings, and issue downgrades that are less informative."

–Dimitrov, Palia and Tang (JFE, 2014)

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Argue that we need to think **jointly** about securitization and ratings to understand implications for the supply of credit

- Is mandatory retention + better ratings a good idea?

Explore how endogenous retention + credit ratings affect the tradeoff between

- Productive efficiency–the set of loans originated

- Allocative efficiency–allocation of their cash flow rights

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Preview of Findings

Without ratings:

- The signaling mechanism provides incentives for making good loans that are quite strong
- Lending standards are too tight and credit supply is restricted

With ratings:

- Costly retention is reduced
- Lending standards and average loan quality fall
- Supply of credit increases, can result in oversupply of credit

Bottom Line: Ratings improve allocative efficiency, but have ambiguous consequences for productive efficiency

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Related Theoretical Literature

Securitization with ex-ante investment

- Parlour and Plantin (2008), Chemla and Hennessy (2013), Vanasco (2016)

Credit Ratings

- Boot and Milbourn (2006), Skreta and Veldkamp (2009), Bolton et al (2012), Heski and Shapiro (2013), Harris and Opp^2 (2013), Josephson and Shapiro (2015)

Security design

- Nachman and Noe (1994), Duffie and DeMarzo (1999), DeMarzo (2005), Biais and Mariotti (2005), Axelson (2007), Fulghieri et al (2015), Daley et al (2016)

Signaling with ratings

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Outline

- Setup
- Benchmarks
  - Complete Information
  - Originate-to-Distribute
  - Originate-to-Hold
- Endogenous retention
  - Without ratings
  - Introduce ratings
- Extensions
- Conclude

Setup

- Players
  - Borrowers (passive)
  - Lender (the "Bank")
  - Competitive Investors
- Bank makes decisions over two stages:
  1. Origination stage
     - Decide which loans to issue
  2. Securitization Stage
     - What portion of loans to securitize
- Investors observe decision in second stage (but not the first)
  - Market price for securities determined

Origination stage

- Bank has a continuum of loan opportunities, $q \in [0, \infty)$
  - Each loan requires one unit of capital
  - Two types of loans: $t \in \{bad, good\}$ (ex-ante unknown)
  - Type t loan generates a random future cash flow $Y \sim G_t$, where $v_t \equiv \mathbb{E}[Y|t]$ and

$$v_b < 1 < v_g$$

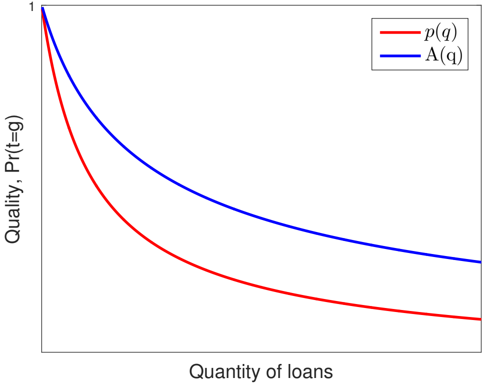
- Prior to funding, bank observes a private signal about each loan

$$p(q) = \Pr(t(q) = good)$$

and decides (privately) whether to fund each loan.

Distribution of loan opportunities

Without loss, assume $p(q)$ is decreasing



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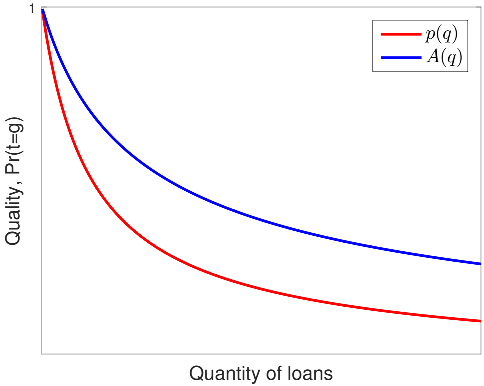

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Socially efficient origination

The expected social value from funding loan q is

$$\underbrace{p(q)v_b + (1 - p(q))v_g - 1}_{NPV_q}$$

It is socially efficient to originate loans to all q with

$$p(q) \geq \frac{1 - v_b}{v_g - v_b}$$

Assumption

1. $p(0) > \frac{1-v_b}{v_g-v_b}$
2. *There exists* $q > 0$ *such that* $p(q) \leq A(q) < \frac{1-v_b}{v_g-v_b}$

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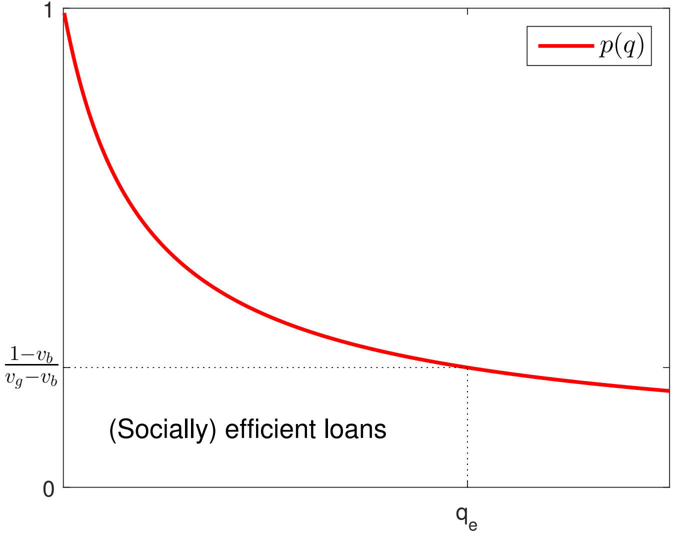
Productive efficiency



Securitization stage

For each loan originated, bank can sell a security backed by its cash flows

- Security promises to pay investors $F(x, y)$
  - y is the realized cash flow from the loan
  - $x \in [0, 1]$ is the "retention level"
    - $x = 1$ means retaining the entire asset: $F(1, y) = 0$
    - $x = 0$ means selling the entire asset: $F(0, y) = y$

Given (x, y)

- The payment to investors is $F(x, y) \in [0, y]$
- The cash flow retained by the bank is $y - F(x, y)$

Take F as a primitive

- Reduces signal space to single dimension
- Feasibility: limited liability + monotonicity

Securitization stage

For each loan originated:

- Bank observes t and chooses retention level x
- Investors observe x, then bid competitively for the security $F(x, \cdot)$
  - Let P denote its equilibrium price
- Cash flow from loan, y, realized:
  - Payoff to investor
  $$F(x, y) - P$$
  - Payoff to bank
  $$P + \delta(y - F(x, y)),$$
  where $\delta < 1$ is (opportunity) cost of retention.

Examples of Securities

(i) Sell equity, retain equity: x is fraction retained.

$$F(x, y) = (1 - x)y$$

(ii) Sell debt, retain equity: $D = (1 - x)\bar{y}$ is face value.

$$F(x, y) = \min\{y, D\}$$

(iii) Sell equity, retain debt: $D = x\bar{y}$ is face value of retained debt.

$$F(x, y) = \max\{0, y - D\}.$$

Will focus on (i) for this talk...

- Results still hold for (ii) and (iii) or when $x = F$
- More on this later, see also Daley et al (2016)

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Equilibrium

The securitization stage is a signaling game, let μ_0 denote investors' prior belief about average loan quality.

Equilibrium Definition

1. Given μ_0, the bank and investors strategies are a PBE of the signaling game that satisfies D1

2. The signaling game implies profits from each type of loan, (u_g, u_b). Bank's funding threshold q^* satisfies

$$p(q^*)u_g + (1 - p(q^*))u_b - 1 = 0$$

3. Investor's beliefs in the signaling game are consistent with q^*

$$\mu_0 = A(q^*)$$

Complete-Information Benchmark

Suppose that investors can observe loan quality t:

- No scope for bank to signal through costly retention or ratings to convey information
- Equilibrium price is $P = v_t$

Bank chooses threshold q^* to solve

$$q^* \in \arg\max_q \, q \cdot \left(A(q) v_g + (1 - A(q)) v_b - 1 \right)$$

Result

The equilibrium of the complete-information benchmark is socially efficient. It features:

- *Allocative efficiency:* $x_g = x_b = 0$
- *Productive efficiency:* $p(q^*) = \frac{1 - v_b}{v_g - v_b}$

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Originate-to-Distribute Benchmark

Suppose the bank sells 100% of each loans it originates

- No signaling through retention

Then

- The price for g and b loans must be the same: P_d
- In equilibrium, it must be that $P_d = 1$
- Investors break even condition implies

$$A(q_d)v_g + (1 - A(q_d))v_b = 1$$

- Too much credit, NPV of average loan is zero!

NB: Bank has incentive to retain some portion of good loans to signal quality

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Originate-to-Hold Benchmark

Suppose the bank retains 100% of each loans it originates

- No signaling through retention

Then

- Banks' value for type-t loan is δv_t
- Optimal origination threshold solves

$$p(q_h)\delta v_g + (1 - p(q_h))\delta v_b = 1$$

- Too few loans are made, lending standards too high

NB: Bank has incentive to sell (at least) some portion of its loan portfolio

Endogenous retention without ratings

Without ratings, the unique stable outcome in the signaling game is the *least-cost-separating-equilibrium* (LCSE).

In the LCSE

- Bank sells all b loans ($x_b = 0$), security sells for

$$P(0) = \mathbb{E}^b[Y] = v_b$$

- Bank retains $\bar{x} \in (0, 1)$ of g loans, security sells for

$$P(\bar{x}) = \mathbb{E}^g[F(\bar{x}, Y)] = (1 - \bar{x})v_g$$

- The retention level $\bar{x}$ is such that

$$v_b = \underbrace{P(\bar{x}) + \delta(v_b - \mathbb{E}^b[F(y, \bar{x}])}_{\text{Payoff from mimicking}}$$

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Credit supply without ratings

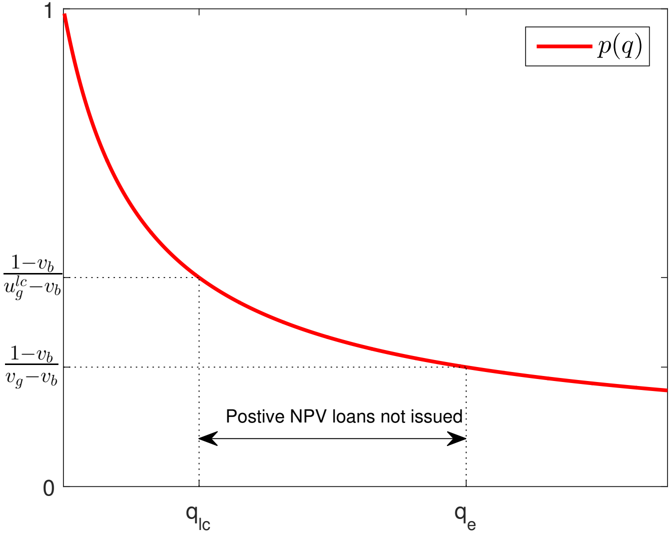
Result

In the LCSE, $u_b = v_b$ *while* $u_g < v_g$. *Therefore,*

$$p(q^{LCSE}) = \frac{1 - v_b}{u_g - v_b} > \frac{1 - v_b}{v_g - v_b} = p(q_e).$$

Without ratings, credit supply is restricted.

Equilibrium credit supply without ratings



Adding Ratings to the Model

- Origination stage: as before
- Securitization stage:
  - For each loan, bank privately observes t, chooses x
  - Ratings: for each security, investors observes rating R
  - Market clearing: investors update beliefs based on (x, R) and bid for each security, market clearing prices are determined

Simplest possible model of ratings?

- An informative signal about t: $R \sim f_t$
- Informativeness of rating r is $\Gamma(r) = \frac{f_b(r)}{f_g(r)}$

Lots of other considerations:

- Endogenous, costly, manipulable, etc...more on this later

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Equilibrium of Securitization Stage

Without ratings:

- Equilibrium satisfying standard refinements is LCSE.
- Independent of μ_0.

Result

With sufficently informative ratings, the equilibrium of the securitization stage involves some degree of pooling which depends on μ_0:

- For $\mu_0 < \mu^*$, it involves partial pooling at some $x^* \in (0, \bar{x})$
- For $\mu_0 > \mu^*$, it involves full pooling at some $x(\mu_0) < x^*$

Intuition:

- Bank needn't signal as vigorously to convey security type
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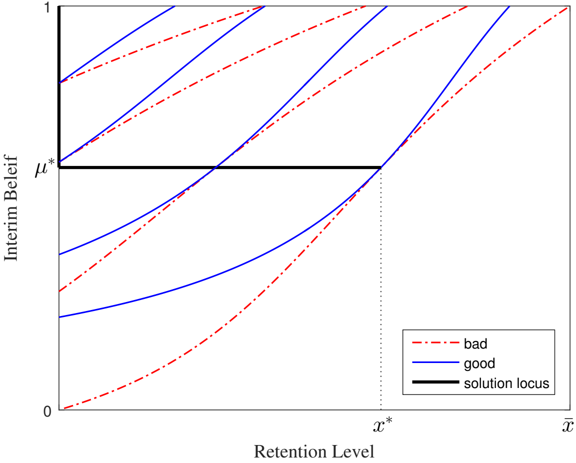
Details

Graphical Intuition



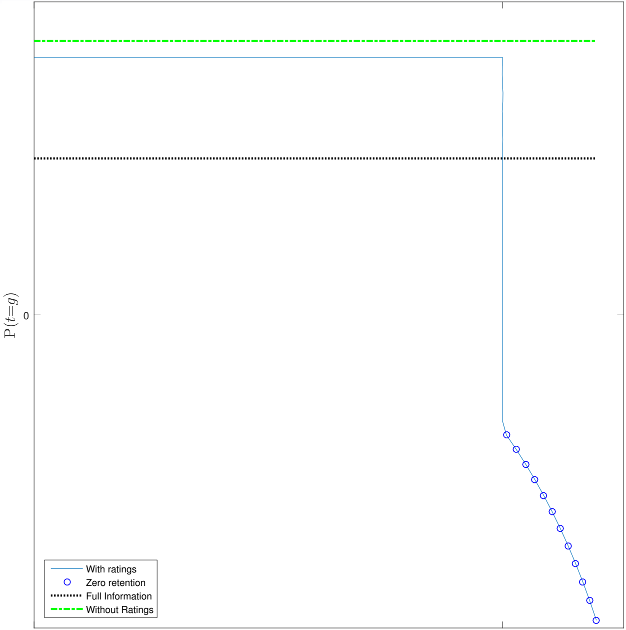
Origination with ratings

To understand the implications for loan origination:

- Note that payoffs in the securitization stage depend on investors belief about average loan quality
- The marginal loan is such that

$$p(q^*) = \underbrace{\frac{1 - u_b(\mu_0)}{u_g(\mu_0) - u_b(\mu_0)}}_{\equiv R(\mu_0)}$$

Marginal loan as it depends on investors' belief



Equilibrium credit supply with ratings

In equilibrium, investors' belief must be consistent with the banks issuance policy, which must be optimal given investors' belief...

That is, if (q^*, μ_0) is part of an equilibrium, then

- $p(q^*) = R(\mu_0)$, and
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Graphically: the intersection of R and $p(A^{-1})$

Result

There is a unique equilibrium. It may involve more or less credit being supplied than the socially efficient level.

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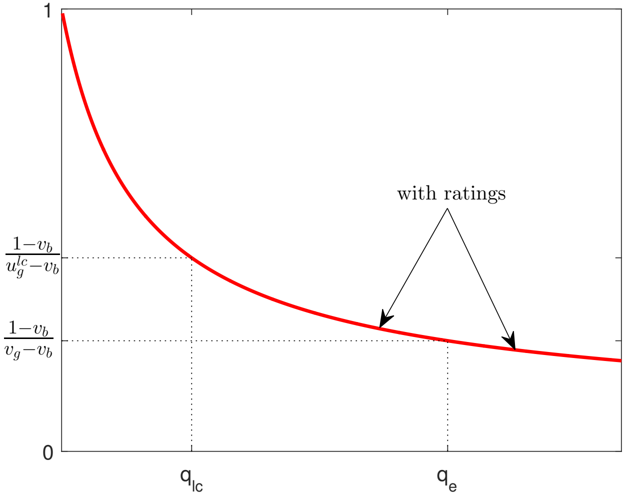
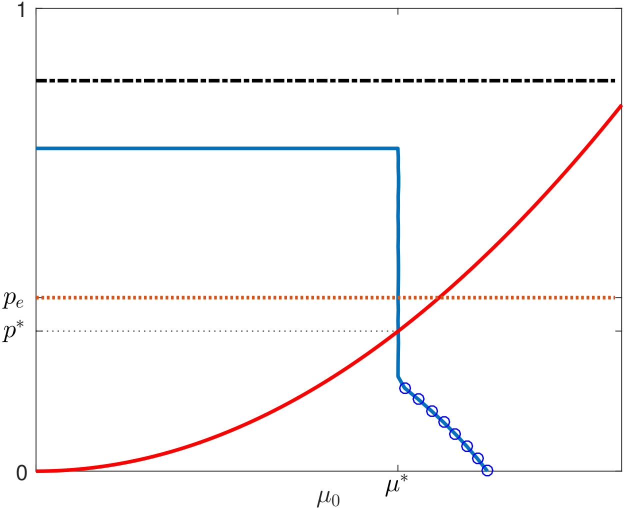


The effect of ratings: oversupply



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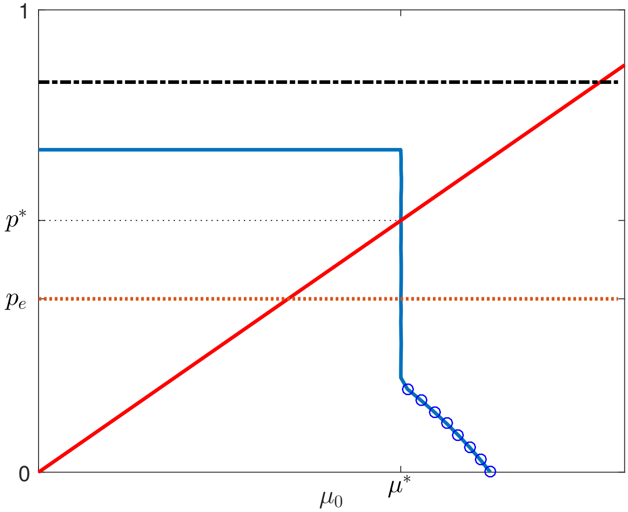

Too much or too little credit?

Oversupply occurs when $p(A^{-1})$ is "sufficiently flat" below μ^*

- Suppose that $F(p) = p^\alpha$
- Higher α corresponds to more right skewed distribution
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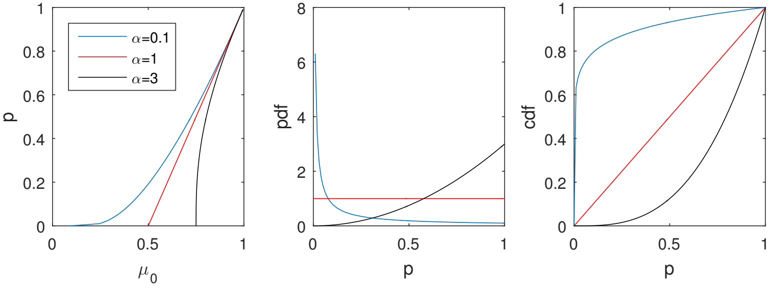

Overall Efficiency with Ratings

Result

Regardless of whether ratings lead to over/under supply, the equilibrium outcome is more efficient with ratings than without ratings.

Why?

- All surplus goes to bank shareholders
- Surplus from both g and b-backed securities (u_g, u_b) is higher with ratings than without

$$\underbrace{\max_q q\left(A(q)u_g^* + (1 - A(q))u_b^* - 1\right)}_{\text{with ratings}} > \underbrace{\max_q q\left(A(q)u_g^{LC} + (1 - A(q))u_b^{LC} - 1\right)}_{\text{without}}$$

Caveat: Ignores negative externalities of making bad loans

- e.g., systemic risk or default cost to borrowers

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Rating informativeness

Suppose rating is binary and symmetric:

$$\gamma = P(R = 1|g) = P(R = 0|b) > \frac{1}{2}$$

Higher γ implies a more informative rating

Result

As γ increases, μ^* and x^* decrease.

- *Equilibrium becomes more efficient*
- *Effect on credit supply and average loan quality is ambiguous*

Implication: More informative ratings improve allocative efficiency not productive efficiency.

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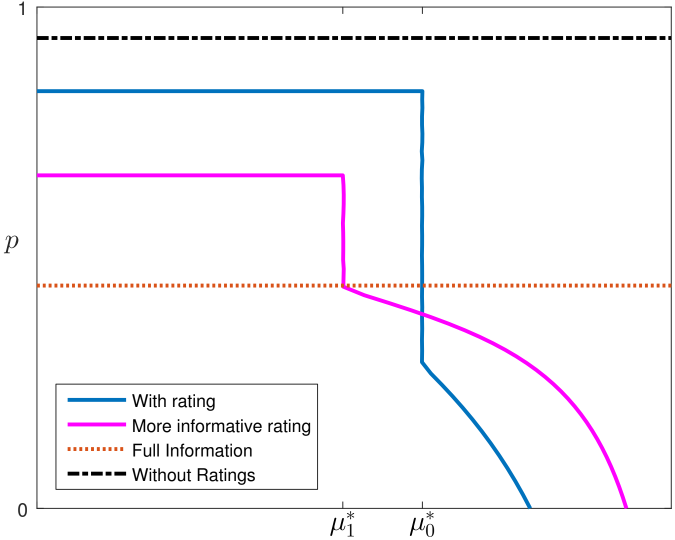

Is there enough skin in the game?

Consider a policy requiring a minimum level of "skin in game"

- Call this level $\underline{x}$
- e.g., Dodd-Frank requires 5% retention for non-exempt ABS

Since bank must retain at least $\underline{x}$, of b-backed securities,

- $u_b(\mu_0)$ decreases
- $x^*(\mu_0)$ increases $\implies$ $u_g(\mu_0)$ also decreases
- $R(\mu_0)$ weakly increases $\implies$ credit supply is more restricted

Result

A policy that requires mandatory "skin in the game"

- *Decreases credit supply and overall efficiency*
- *Increases average loan quality*

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Endogenous Ratings

To this point, we have taken ratings as exogenous. But...

- Empirical evidence of rating shopping
- Anecdotal evidence of rating manipulation
- Getting rated is costly (issuer pays)

We consider several extensions to allow for these possibilities

- Rating informativeness is now endogenously determined

Main Takeaway

- Shopping and/or manipulation has similar effects to a reduction in rating informativeness provided investors are fully rational.

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Rating manipulation

Suppose bank can pay a cost m to manipulate the rating of a b-backed security. E.g.,

- Bribe paid directly to rating agency
- Cost of obscuring true value of underlying

For simplicity, assume manipulation leads to the same rating distribution as g-backed security.

- Recall that (x^*, μ^*) is the pooling action/belief absent manipulation
- The gain from manipulation is

$$\Delta = \overbrace{(\alpha_g(\mu^*) - \alpha_b(\mu^*))}^{\text{informativeness of rating}} \underbrace{(1 - x^*)(v_g - v_b)}_{\mathbb{E}(F|g) - \mathbb{E}(F|b)}$$

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Some manipulation takes place $\iff m < \Delta$.

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Rating manipulation

Are investors aware of ability to manipulate (i.e., fully rational)?

1. Suppose they are
   - Bank manipulates only a fraction of b-backed securities
   - Ability to manipulate effectively makes ratings are less informative
   - Effect of manipulation similar to a decrease in γ

2. Suppose they are not
   - Bank manipulates all b-backed securities if $m < \Delta$
   - $u_b(\mu_0) \uparrow$, $u_g(\mu_0)$ unchanged, $R(\mu_0) \downarrow$
   - Credit supply increases, efficiency decreases, investors make losses
   - Could justify policy of mandatory skin in the game in this case

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Security Design

To this point, we have focused on how much the bank will retain taking the "class" of securities, $\{F(\cdot, x)\}_{x \in [0,1]}$, as given.

Now suppose in the securitization stage, the bank can choose any design, F, such that:

- $F(y) \in [0, y]$,
- $F(y)$ and $y - F(y)$ are (weakly) increasing.

Question: How do ratings affect the security design?

Security Design: Results

1. Without ratings, the bank sells debt and retains equity.
    - Debt is minimally information sensitive,
    - Equity is maximally information sensitive
    - Selling debt and retaining equity is most effective way to signal
2. With ratings, the security design depends on the relation between the rating informativeness, RI, and the cost of retention, δ:
    - If $RI < \delta$, then the bank sells debt and retains levered-equity.
    - If $RI > \delta$, then the bank sells levered-equity and retains debt.
    - If $RI = \delta$, the design of the security is indeterminate.

Rating Informativeness:

$$RI = \max_{\mu} \alpha_g(\mu) - \alpha_b(\mu)$$

Intuition: informationally sensitive securities are most sensitive to ratings, willingness to retain exposure to ratings is most effective signal .

Security Design: Argument

Let $u_t(F,\mu)$ be t's expected payoff from selling F with interim belief μ.

For given μ and k, let $\mathcal{F}(\mu,k) \equiv \{F : u_L(F,\mu) = k\}$.

In any equilibrium satisfying refinements, if $\mu > 0$ and (F,μ) is on path, then F solves,

$$\begin{aligned} &\max_{F \in \mathcal{F}(\mu,k)} \; u_g(F,\mu) \\ = &\max_{F \in \mathcal{F}(\mu,k)} \; \underbrace{\alpha_g \mathbb{E}[F|g] + (1-\alpha_g)\mathbb{E}[F|b]}_{\text{Expected } P(F) \text{ given } t=g} + \delta(v_g - \mathbb{E}[F|g]) \end{aligned}$$

(note: without ratings, $\alpha_g = \alpha_b = \mu$, so there is no difference in expected price, just difference in opportunity cost of sale.)

Security Design: Argument

Objective:

$$\max_{F \in \mathcal{F}(\mu,k)} \ \alpha_g \mathbb{E}[F|g] + (1-\alpha_g)\mathbb{E}[F|b] + \delta(v_g - \mathbb{E}[F|g])$$

Substitution in from the constraint, we get

$$\max_{F \in \mathcal{F}(\mu,k)} \ \big(\alpha_g - \alpha_b - \delta\big)\big(\mathbb{E}[F|g] - \mathbb{E}[F|b]\big) + \delta v_g + k$$

Hence, solution is "bang bang"

- If $\alpha_g - \alpha_b < \delta$, want to minimize $\mathbb{E}[F|g] - \mathbb{E}[F|b]$.
  - i.e., minimize information sensitivity: sell debt, retain equity.
- If $\alpha_g - \alpha_b > \delta$, want to maximize $\mathbb{E}[F|g] - \mathbb{E}[F|b]$.
  - i.e., maximize information sensitivity: sell equity, retain debt.

Summary

Develop a framework to understand the interaction between ratings, securitization and the supply of credit.

The presence of informative ratings

- Reduces the use costly retention as a signal
- Increases the supply of credit
- Increases overall efficiency (absent negative externalities)
- Reduces average quality of loans issued
- May lead too oversupply of credit relative to first best

Mandatory skin in the game is justifiable if

- Bad loans have negative externalities, and/or
- Investors overestimate rating informativeness

Extensions: Manipulation/shopping endogenize rating informativeness

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Updating and payoffs

Investor's updating can be decomposed into two parts:

(i) Updating based on retention: $\mu_0 \to \mu$

(ii) Updating based on rating: $\mu \to \mu_f$

Given an interim belief μ, the final belief follows directly from Bayes rule

$$\mu_f(\mu, r) = \frac{\mu}{\mu + (1-\mu)\Gamma(r)}$$

Thus, the market clearing price for security F is

$$P(F) = \mu_f \mathbb{E}[F|g] + (1-\mu_f)\mathbb{E}[F|b]$$

Let $\alpha_t(\mu)$ be the t-type expected final market belief

$$\alpha_t(\mu) \equiv \mathbb{E}[\mu_f(\mu, R)|t]$$

The expected payoff of issuing security F backed by a type-t loan is

$$u_t(x, \mu) = \alpha_t \mathbb{E}[F|g] + (1-\alpha_t)\mathbb{E}[F|b] + \delta \mathbb{E}[Y - F|t]$$

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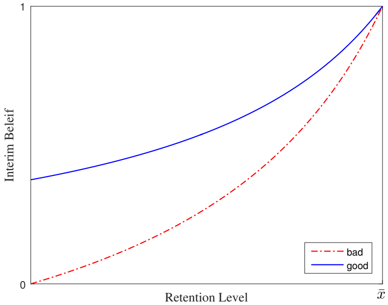
Belief Indifference Curves

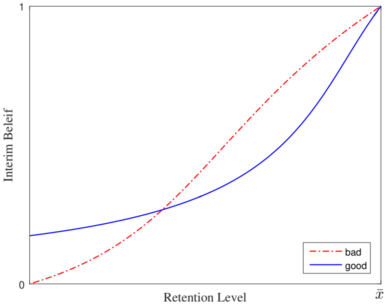
To characterize the equilibrium of the securitization stage with ratings, it is useful to construct belief indifference curves:

- Identify pairs (x, μ) such that $u_t(x, u) = k$ for $k \in [v_b, v_g]$
- Let $\mu_t(x; k)$ denote the "belief indifference curve"

Belief Indifference Curves



No Ratings: Single Crossing



With Ratings: "Double Crossing"

Lemma

In any equilibrium satisfying D1, μ_g must lie weakly above μ_b.

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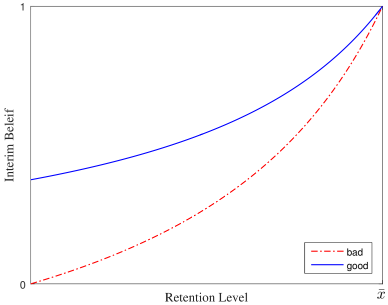

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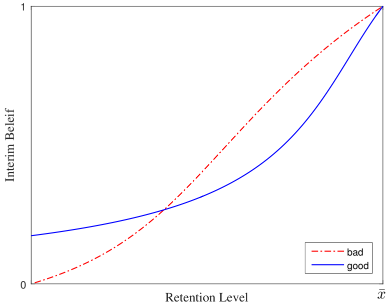

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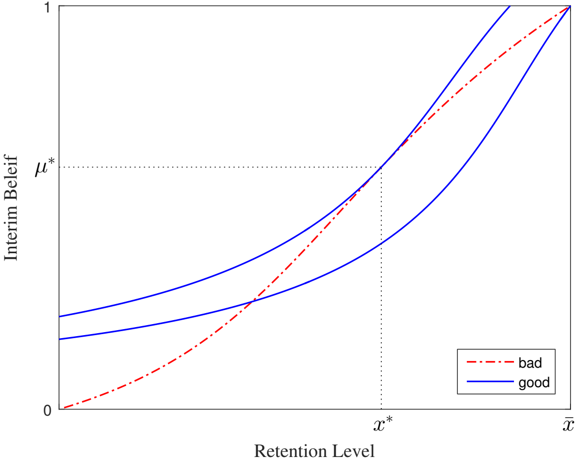
Graphical Intuition



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