Feedback Effects of Credit Ratings

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CREDIT 2011

Feedback Effects of Credit Ratings

- *Independent* opinion on the credit quality of issuers?

Feedback Effects of Credit Ratings

- *Independent* opinion on the credit quality of issuers?
- Credit ratings themselves affect credit quality of issuers.
  - information.
  - regulation.
  - rating triggers.

Example: Enron's Credit-Sensitive Notes

Issued in June 1989 to mature June 2001.

Ratings*		Interest
Moody's	**S&P**	**Rate**
Aaa	AAA	9.20%
Aa1 - Aa3	AA+ - AA-	9.30%
A1 - A3	A+ - A-	9.40%
Baa1 - Baa3	BBB+ - BBB-	9.50%
Ba1	BB+	12.00%
Ba2	BB	12.50%
Ba3	BB-	13.00%
B1 or lower	B+ or lower	14.00%

*if ratings are split, the lower of S&P and Moody's ratings is considered.

Outline of the Talk

1. The Model
2. Equilibrium in Markov Strategies
3. Social Welfare and Equilibrium Selection
4. Stability and the Credit-Cliff Dynamic
5. Competition Between Rating Agencies
6. Equilibrium Computation
7. Comparative Statics
8. Conclusion

Outline of the Talk

Cash Flows, Capital Structure, and Credit Ratings

- Firm generates non-negative after-tax cash flows δ_t

$$d\delta_t = \mu(\delta_t)dt + \sigma(\delta_t)dB_t,$$

- Debt in place promises a non-negative payment rate $C(R_t)$, which is decreasing in the credit rating R_t of the borrower, where $R_t \in \{1, \ldots, I\}$, with 1 the lowest ("C" in S&P's ranking) and I the highest ("AAA" in S&P's ranking).

Optimal Default Time

Given a rating process R, the firm's optimal liquidation problem is

$$W_0 \equiv \sup_{\widehat{\tau} \in \mathcal{T}} E\left[\int_0^{\widehat{\tau}} e^{-rt}\left[\delta_t - (1-\theta)C\left(R_t\right)\right] dt\right].$$

Accurate Credit Ratings

The rating agency is concerned about its reputation, which depends on the accuracy of its ratings.

Given a default policy $\widehat{\tau}$, a rating process R is *accurate* if

$$R_t = i \text{ whenever } P(\widehat{\tau} - t \leq T \mid \mathcal{F}_t) \in [G_i, G_{i-1}),$$

where $\{G_i\}_{i=0}^{I}$ with $G_0 = 1$, $G_I = 0$, and $G_i \geq G_{i+1}$ are the target rating transition thresholds.

Equilibrium

An equilibrium (τ^*, R^*) is characterized by the following:

1. Given the rating process R^*, the default policy τ^* maximizes equity value.

2. Given the default policy τ^*, the rating process R^* is accurate.

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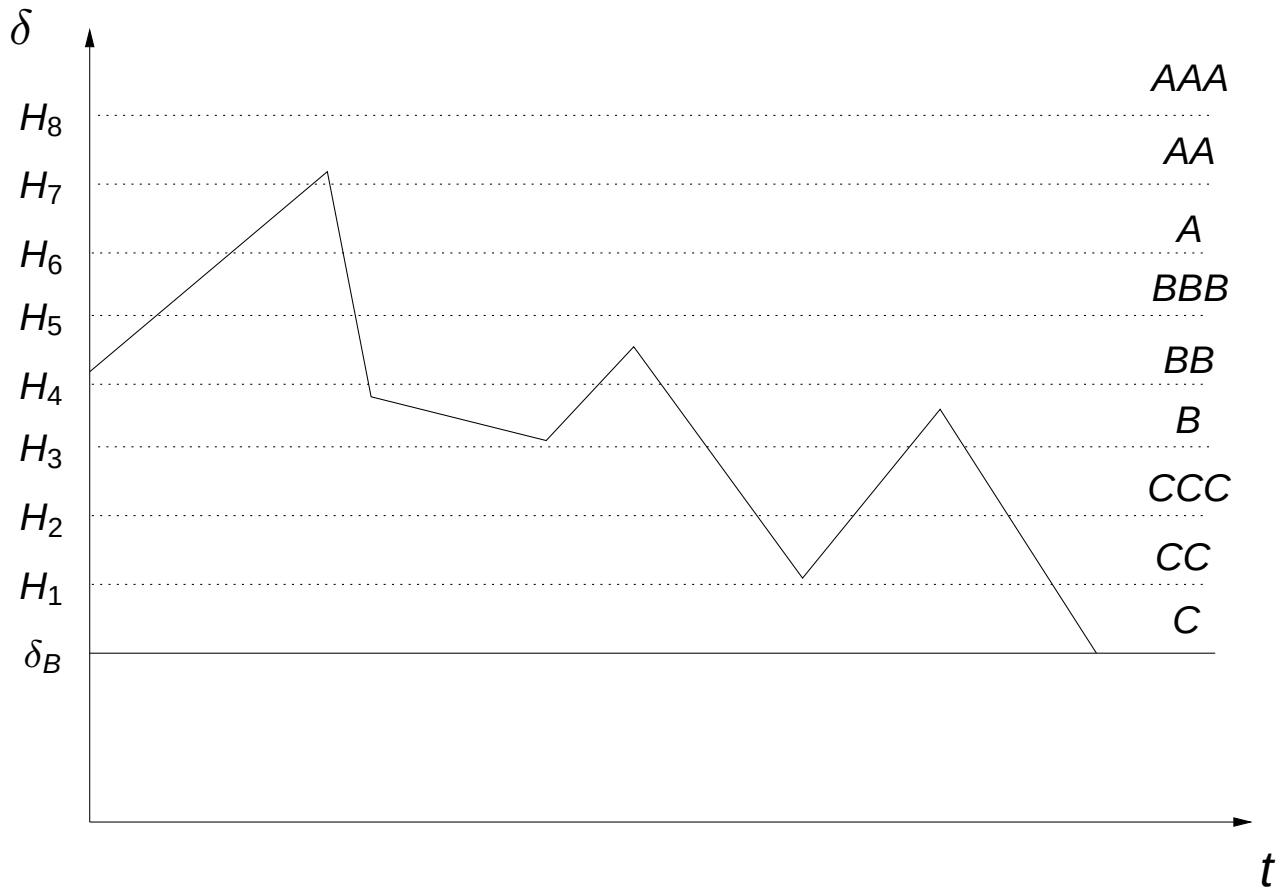
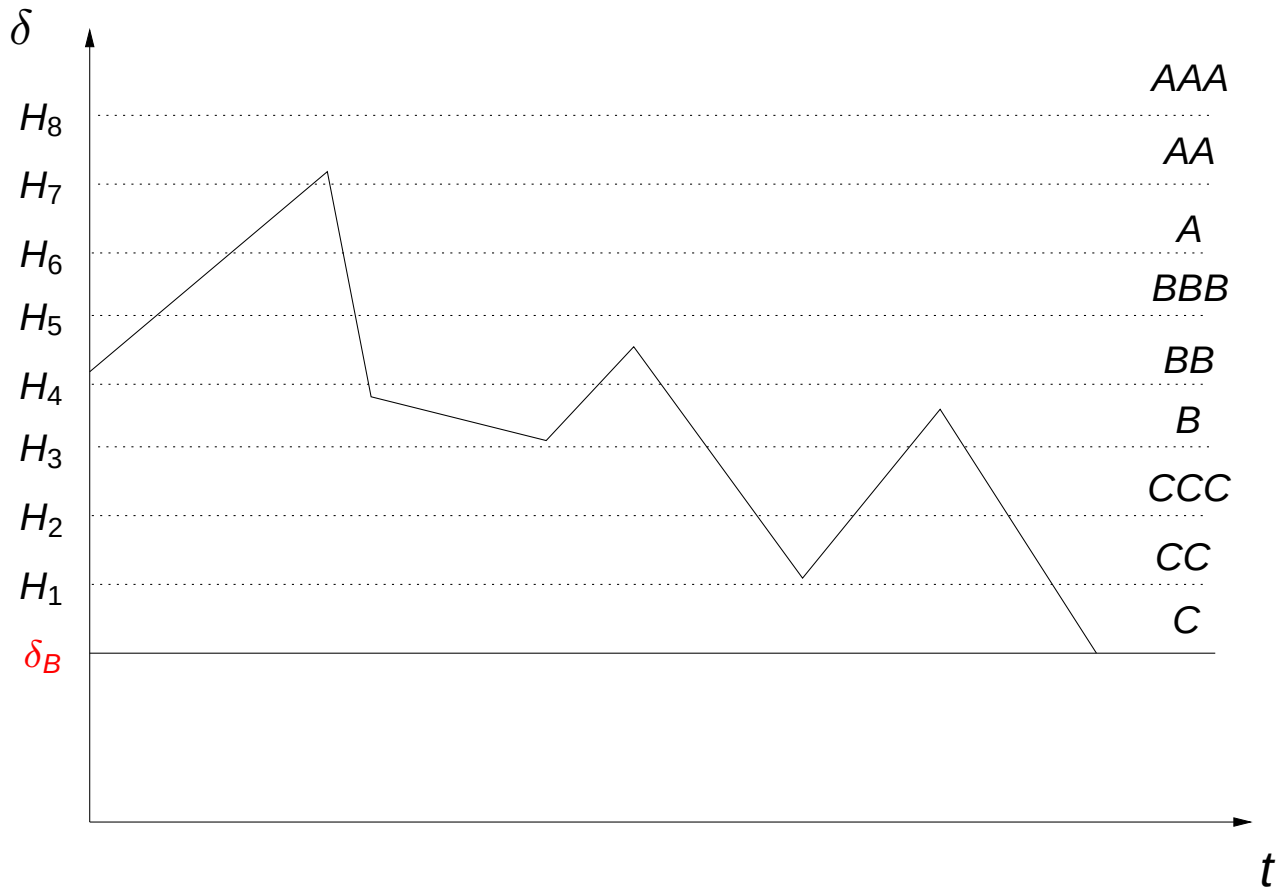
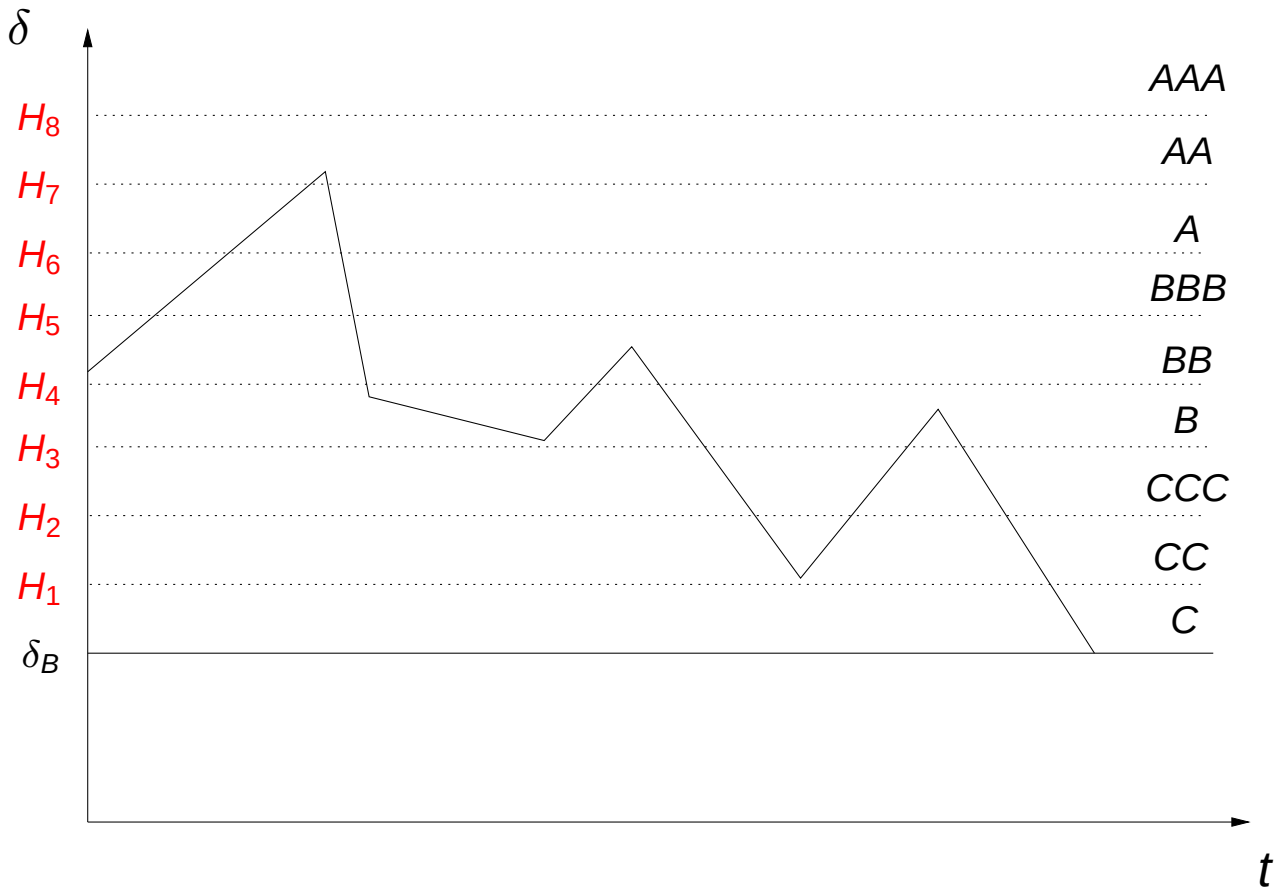
Markov Strategies



Markov Strategies



Markov Strategies



Optimal Default Threshold δ_B

For a given Markov rating policy H, the ratings-based PSD obligation C is equivalent to a step-up PSD obligation C^H. From Manso, Strulovici, and Tchistyi (2010), the equity value W and optimal default threshold δ_B can be computed in the following way:

1. Determine the set of continuously differentiable functions that solve the following ODE

$$\frac{1}{2}\sigma^2(x)W''(x)+\mu(x)W'(x)-rW(x)+x-(1-\theta)C^H(x)=0. \quad (1)$$

   at each of the intervals $[H_i, H_{i-1})$. It can be shown that any element of this set can be represented with two parameters, say L_1^i and L_2^i.
2. Determine δ_B, L_1^i, and L_2^i using the following conditions:

- $W(\delta_B)=0$ and $W'(\delta_B)=0$.
- $W(H_i-)=W(H_i+)$ and $W'(H_i-)=W'(H_i+)$ for $i=1,\ldots,I$.
- W' is bounded.

Accurate Rating Transition Thresholds H

For a given default threshold δ_B, the best-response rating transition thresholds H are such that

$$P(\tau(\delta_B) - t \leq T \mid \delta_t = H_i) = G_i.$$

Because $P(\tau(\delta_B) - t \leq T \mid \delta_t)$ is strictly decreasing and continuous in δ_t, the thresholds H exist and are unique.

Strategic Complementarity

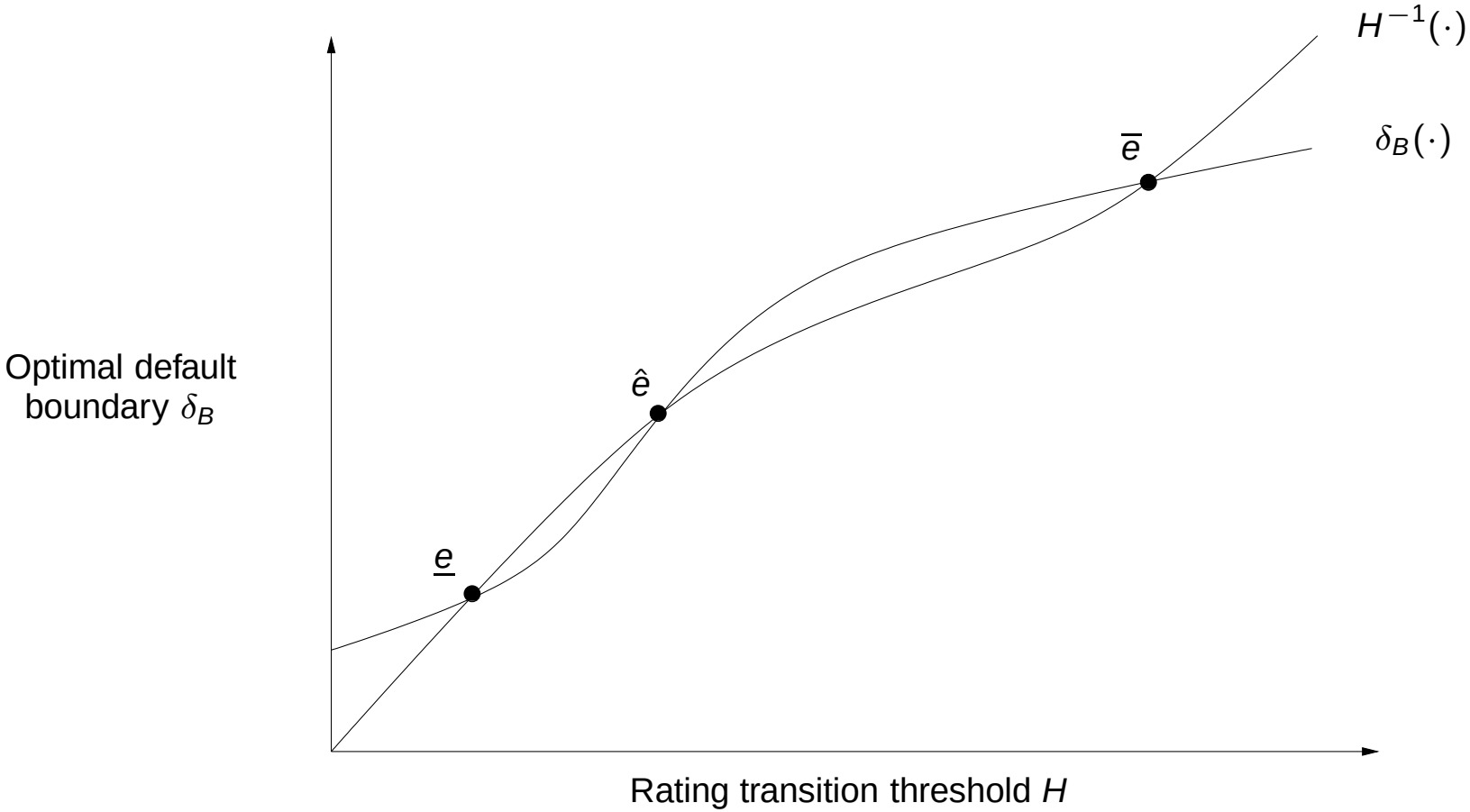
Proposition: The best-response default policy $\delta_B(H)$ is increasing in the rating transition thresholds H.

Proposition: The best-response rating policy $H(\delta_B)$ is increasing in the default threshold δ_B.

Equilibria of the Game

Theorem: The set $\mathcal{E}$ of Markov equilibria has a largest and a smallest equilibrium.

Equilibria of the Game



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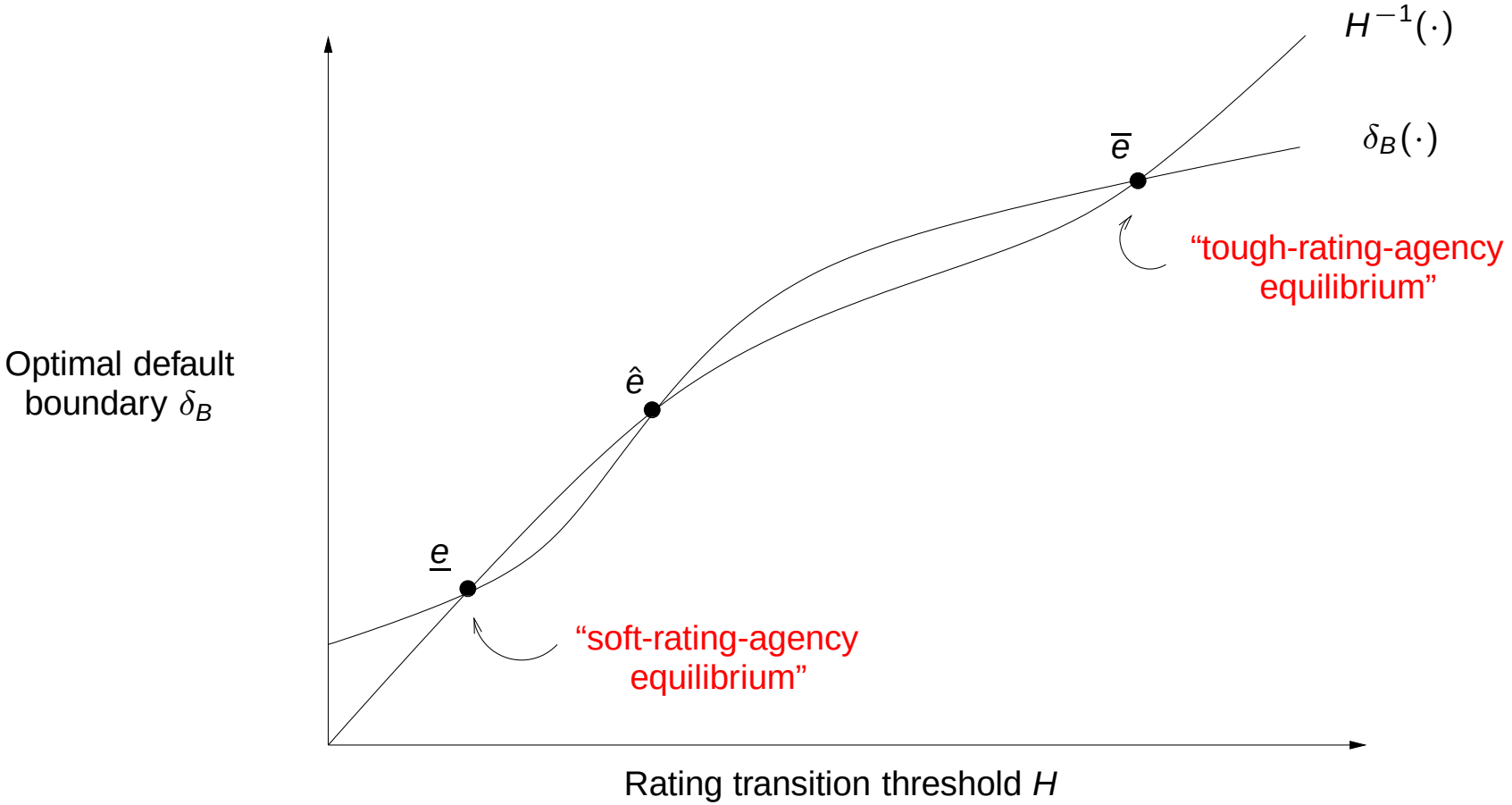
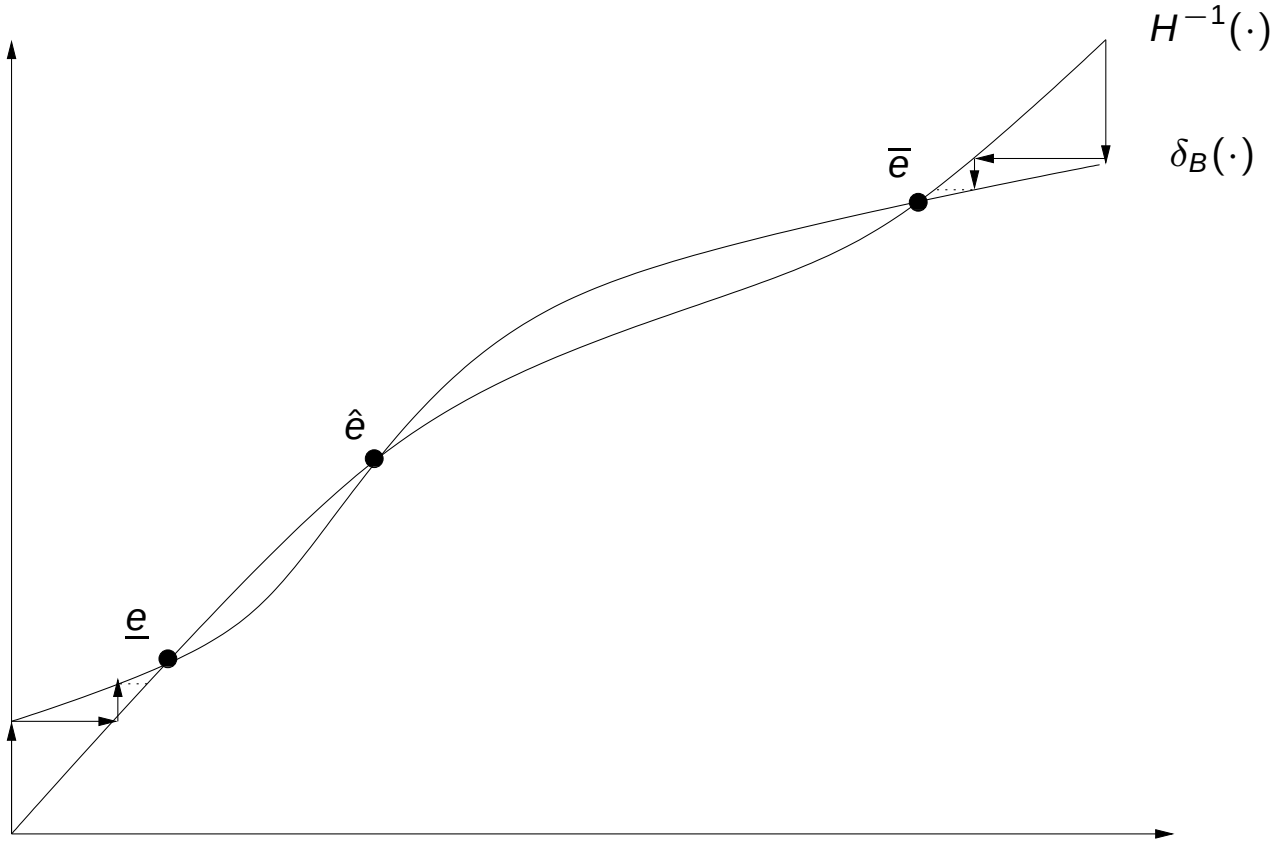


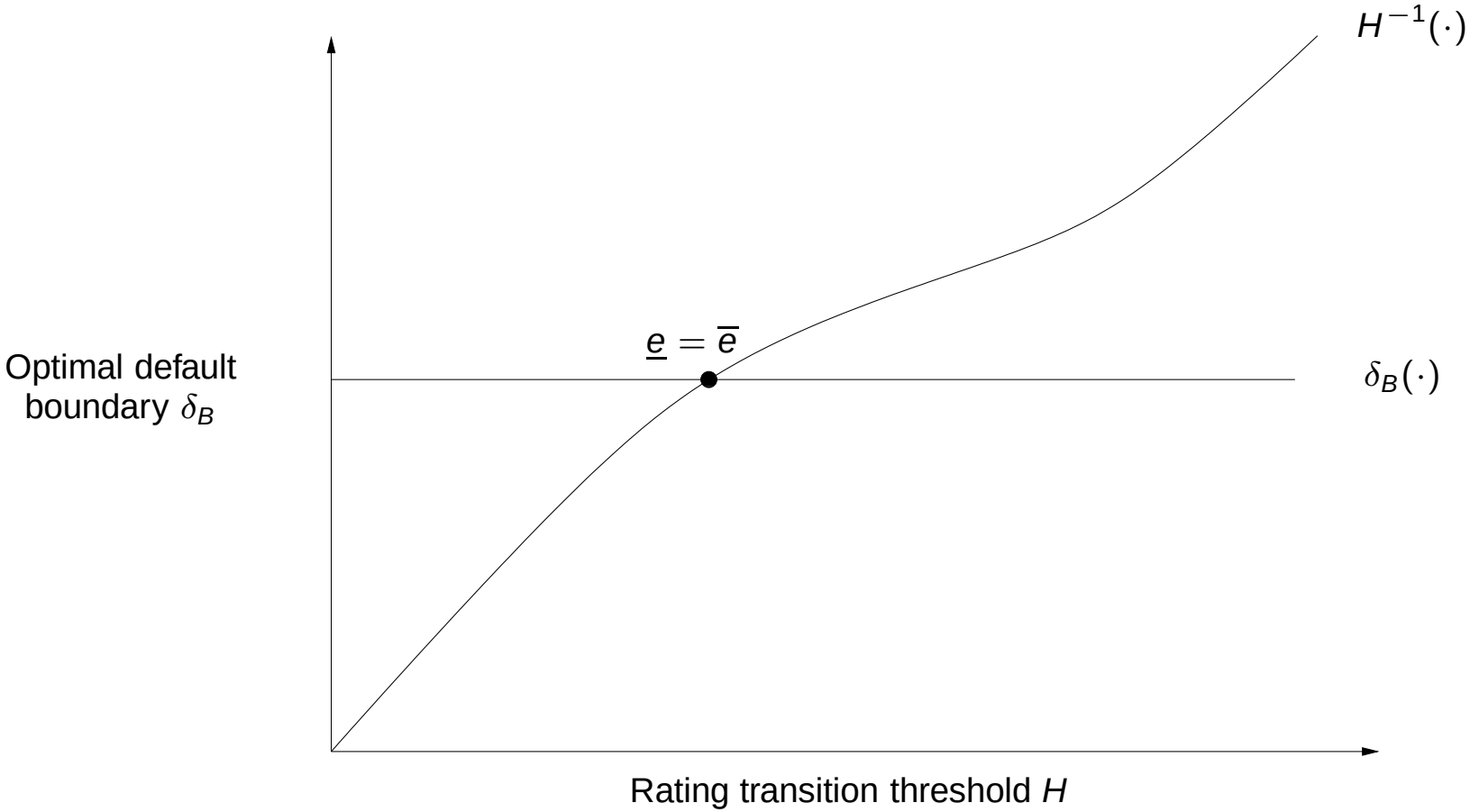
Algorithm to Compute Equilibria



Consol Bond

If C is a fixed-coupon consol bond (i.e. $C(i) = c$ for all i), then the equilibrium is unique.

Consol Bond


$H^{-1}(\cdot)$
$\underline{e} = \overline{e}$
$\delta_B(\cdot)$
Optimal default boundary δ_B
Rating transition threshold H

Outline of the Talk

Social Welfare and Equilibrium Selection

Proposition: Equilibria of the game are Pareto-ranked. The tough-rating-agency equilibrium is the worst equilibrium, while the soft-rating-agency equilibrium is the best equilibrium.

Difficult Problem for Rating Agencies

Standard and Poor's Reaction

How is the vulnerability relating to rating triggers reflected all along in a company's ratings? Ironically, it typically is not a rating determinant, given the circularity issues that would be posed. To lower a rating because we might lower it makes little sense – especially if that action would trip the trigger!

Republished three years later:

The vulnerability relating to rating triggers can be reflected all along in a company's ratings. However, there are questions over circularity.

"Playing Out the Credit-Cliff Dynamic,"
Standard and Poor's, December 2001
Republished in October 2004

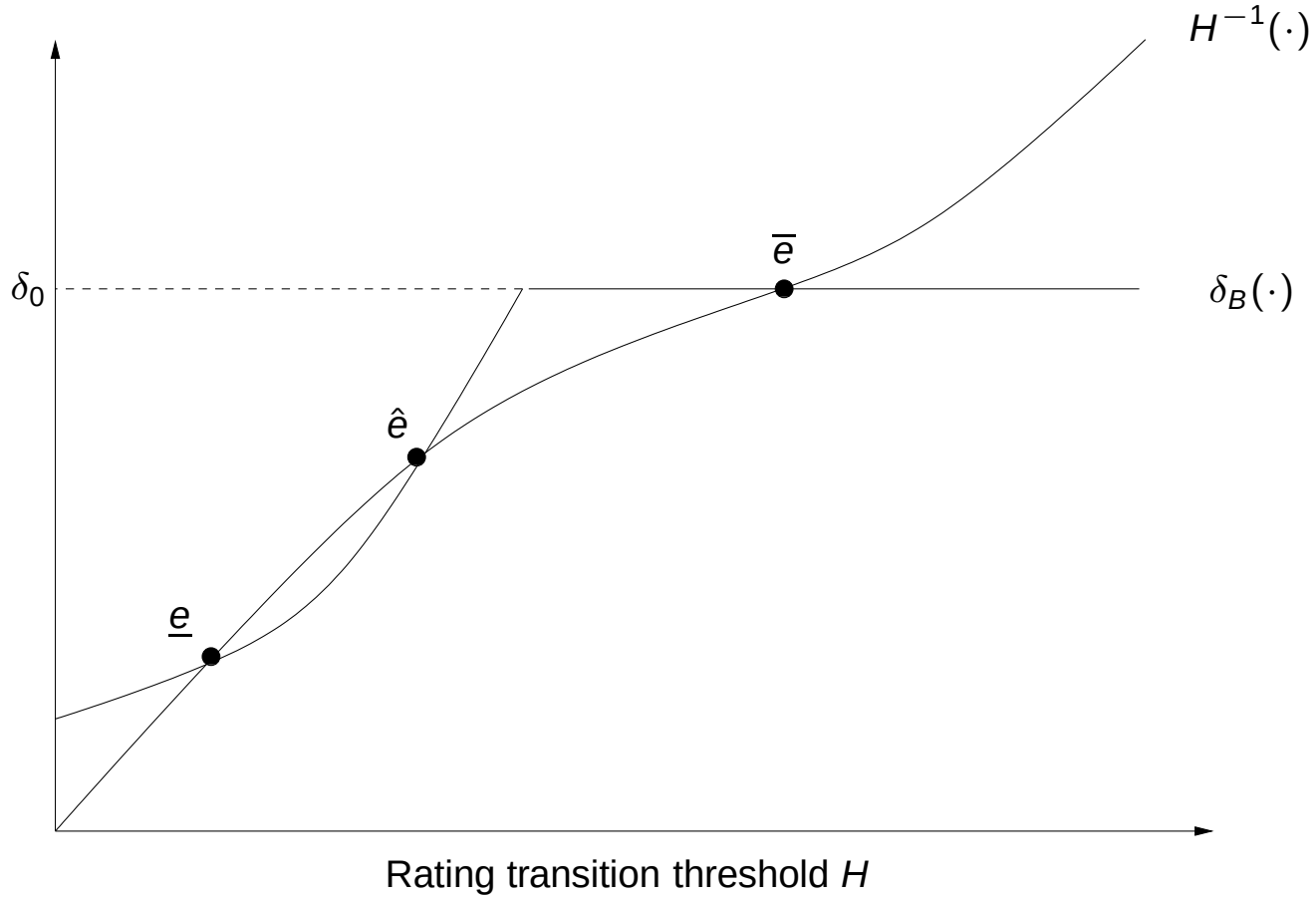
Difficult Problem for Rating Agencies

Moody's Reaction

In conducting its stress case analysis for those issuers that have truly risky rating triggers such as ratings-based default or acceleration provisions, or "puts" in back-up lines, identures, and counterparty agreements, Moody's must assume that triggers which specify default or acceleration outcomes are set off, and the underlying debt is "put" and or availability under the back-up credit line goes away. This means that the issuer must have the wherewithal to survive such a downgrade and the consequences of the trigger.

"Moody's Analysis of US Corporate Rating Triggers Heightens Need for Increased Disclosure,"
Moody's, July 2002

Negative Consequences of Stress-Test Approach



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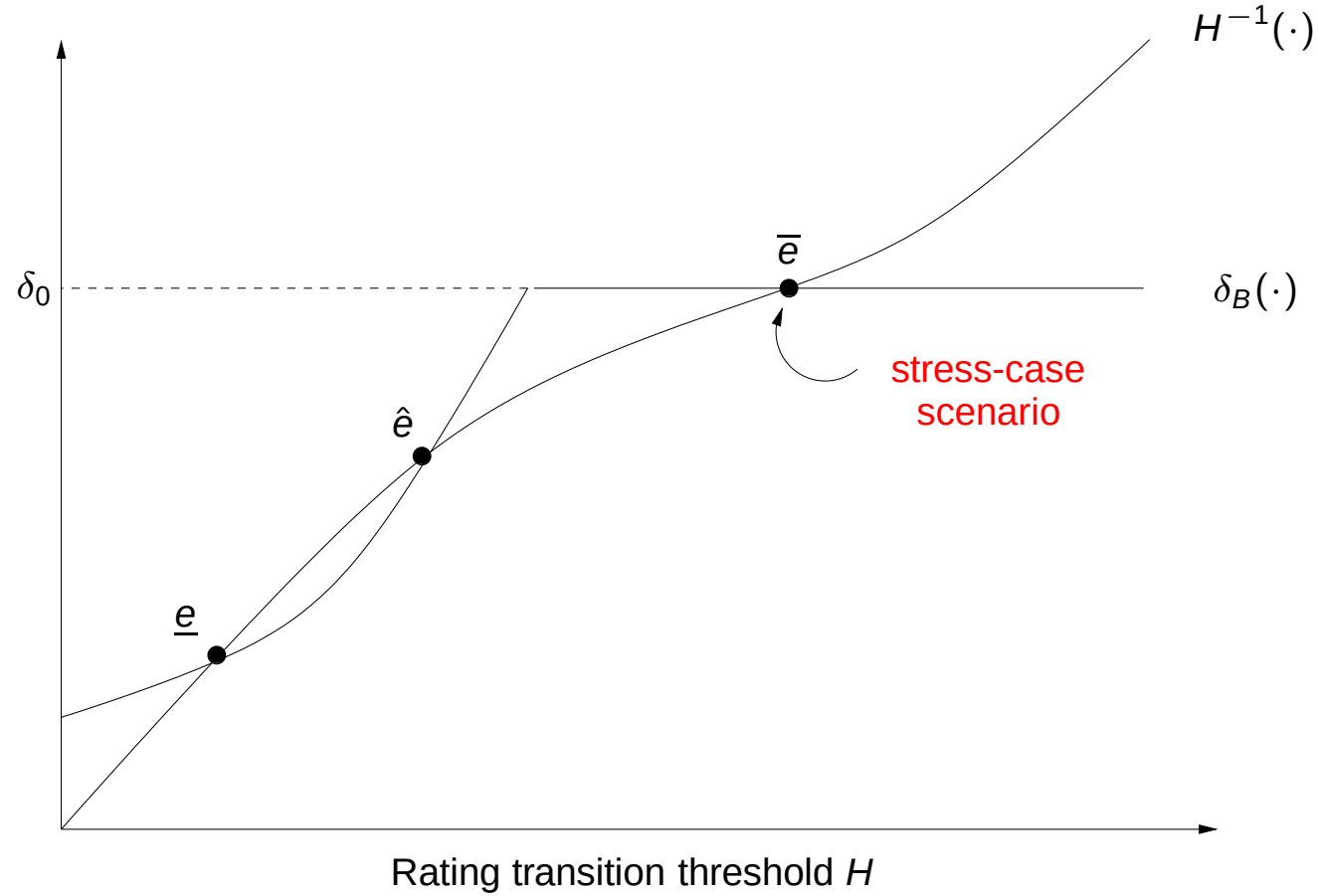


Potential Solution: Issuer-Pay Model

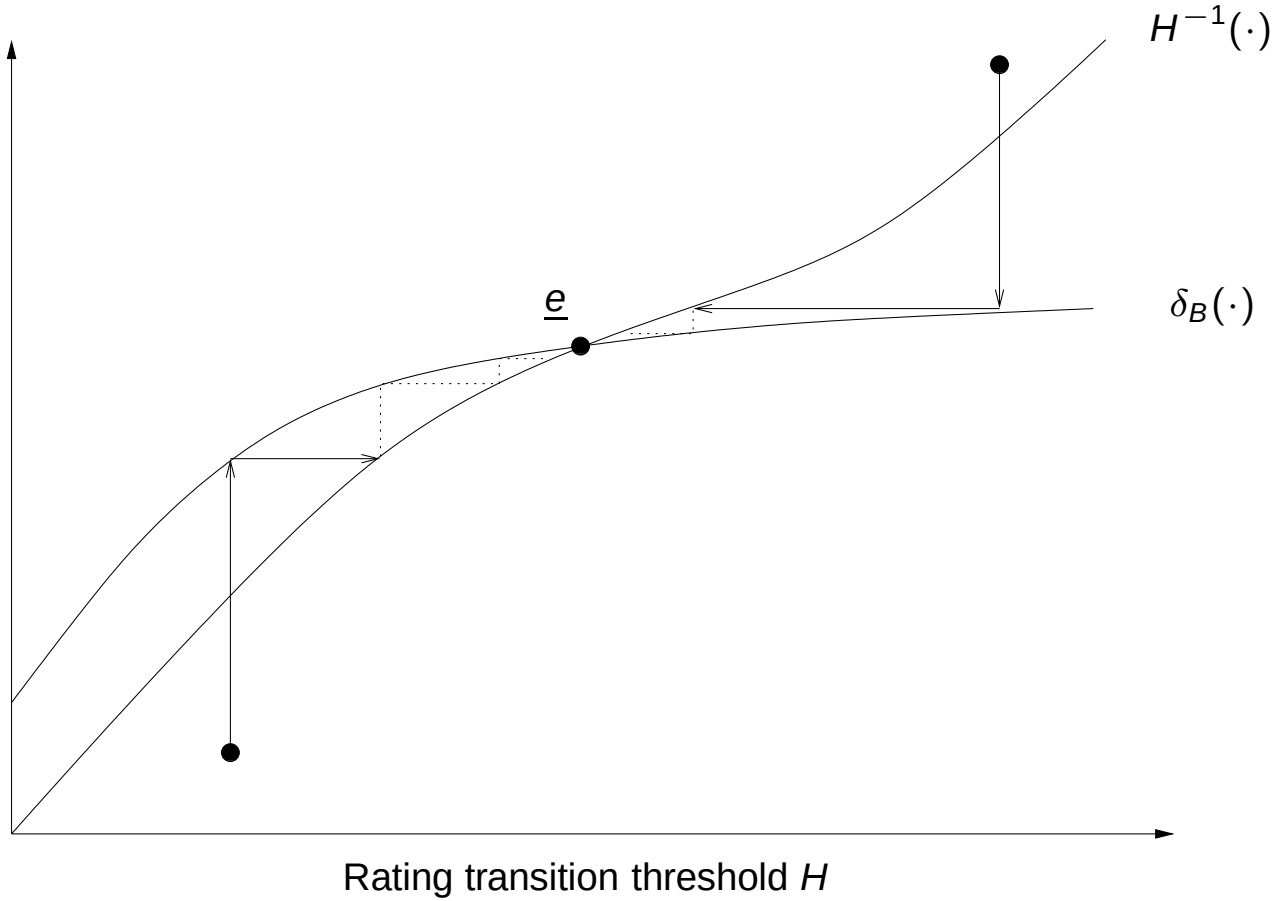
- Issuer pays for being rated.
- Rating agencies become concerned about survival of the issuer.
- If fees from a particular issuer are small relative to reputation concerns, rating agencies will choose the soft-rating-agency equilibrium.

Outline of the Talk

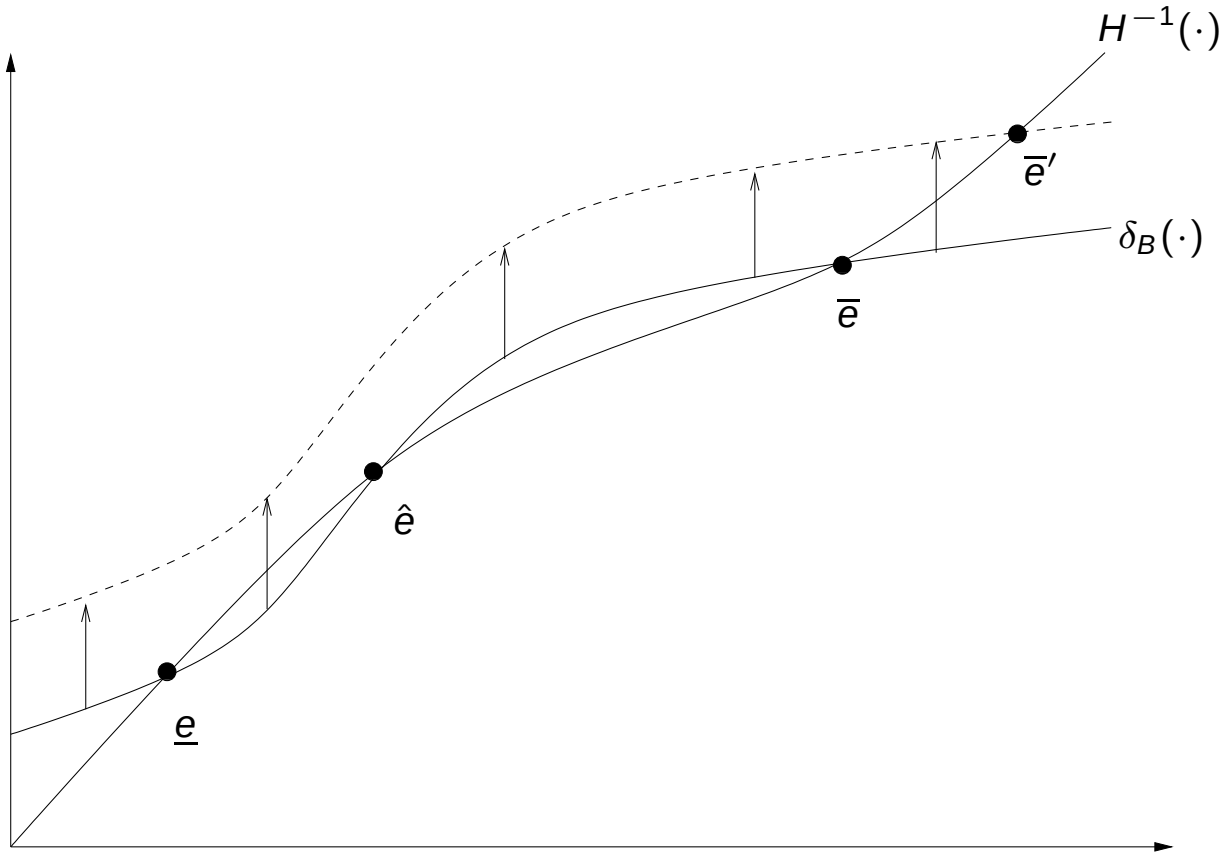
Stability and the Credit-Cliff Dynamic

Proposition: If the game has a unique Markov equilibrium, it is globally stable in terms of best-response dynamics.

Stability When the Equilibrium is Unique



Reaction to a Small Unanticipated Shock



Outline of the Talk

Competition Between Rating Agencies

Same model as before except that there are two rating agencies.

- Objective of each rating agency is to have more accurate ratings than the other rating agency.
- The ratings-based PSD obligation C promises payments $C(R_t^1, R_t^2)$ from the borrowing firm to the debtholders at each time t.

Equilibria with Multiple Agencies

Lemma: With a ratings-based PSD obligation C whose coupon depends on R_t^1 and R_t^2, any equilibrium involves rating agencies choosing symmetric rating transition thresholds ($H^1 = H^2$). The firm default boundary δ_B and the rating transition thresholds H^1 or H^2 are in the equilibrium set $\mathcal{E}$ of the game with a single rating agency.

Coupon Payment When Ratings are Split

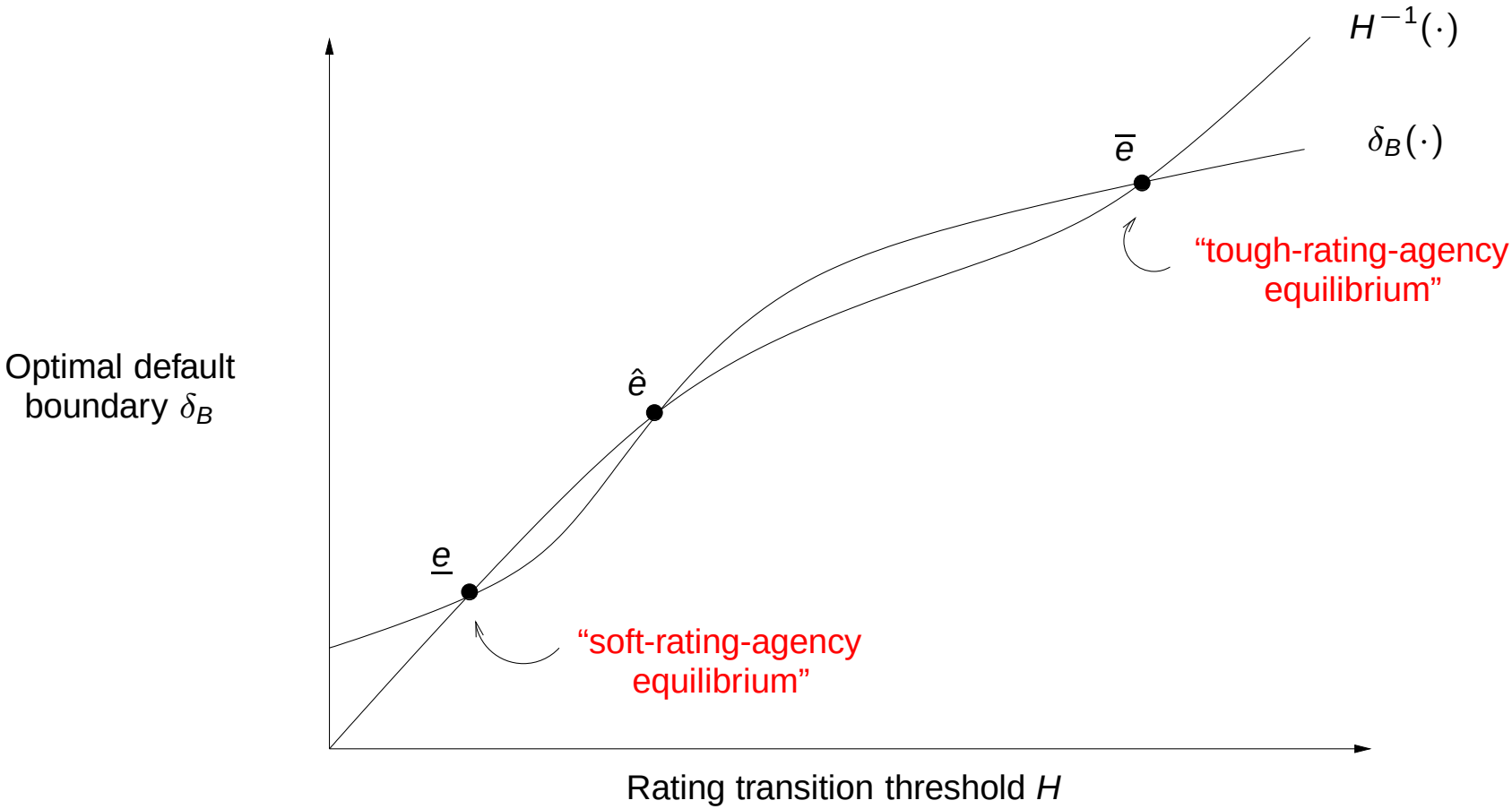
Wiemann (2010) checks 50 randomly selected contracts and finds:

- 22 contracts rely on the maximum rating.
- 20 contracts rely on the minimum rating.
- 8 contracts rely on an average rating.

Equilibria Under the Maximum and Minimum Criteria

Proposition: If the ratings-based PSD obligation C relies on the minimum (maximum) of the ratings, then the unique Markov equilibrium of the game is the tough-rating-agency (soft-rating-agency) equilibrium.

Which Equilibrium Survives Under the Minimum Criterion?



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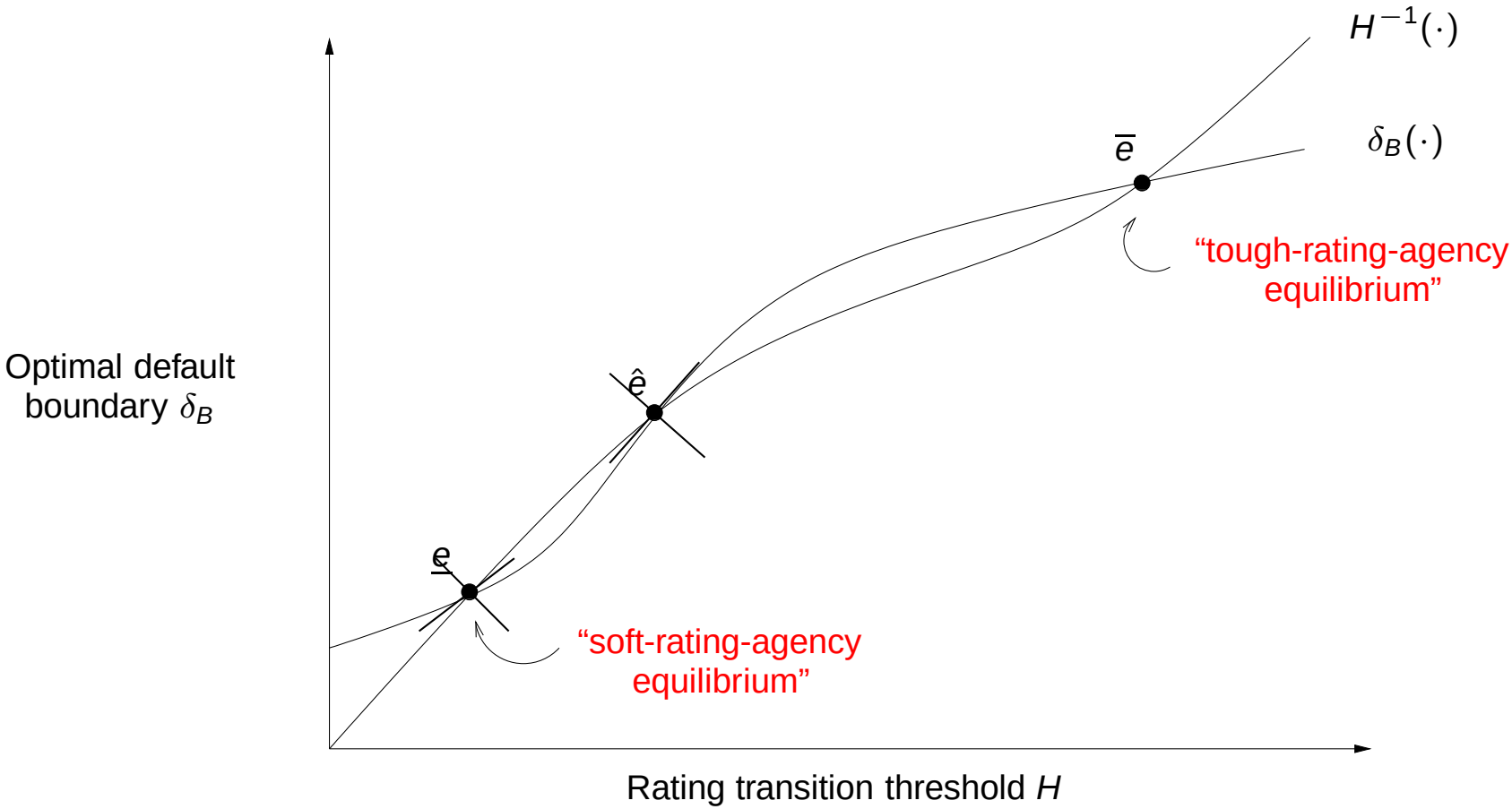

Competition in Practice

Earlier this month, Standard & Poor's lowered its credit rating on Chicago-based GATX Corp., which leases rail cars and aircraft. The reason? The company's access to the commercial-paper market was curtailed, due to a downgrade by rival Moody's, which cited concerns about volatility in the aircraft-leasing business.

Wall Street Journal, March 28, 2002.

Outline of the Talk

Geometric Brownian Motion Cash Flows

Cash flows follow a Geometric Brownian motion process

$$d\delta_t = \mu\delta_t dt + \sigma\delta_t dB_t, \tag{2}$$

where μ is the drift and σ is the diffusion.

Geometric Brownian Motion Cash Flows

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$$d\delta_t = \mu\delta_t dt + \sigma\delta_t dB_t, \tag{2}$$

where μ is the drift and σ is the diffusion.

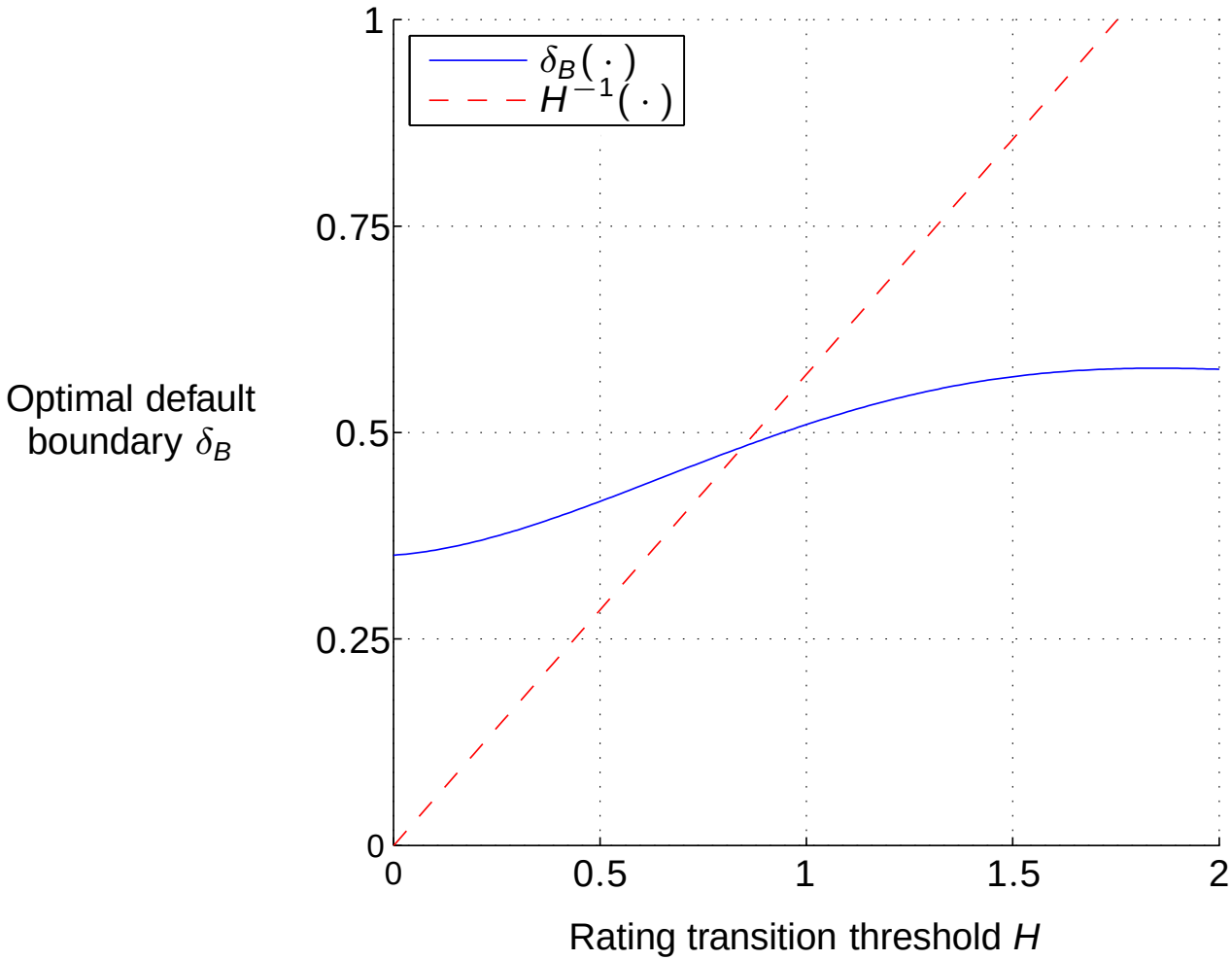
Unique equilibrium in closed-form:

$$\delta_B^* = \frac{\gamma_1(r-\mu)}{(\gamma_1+1)r}\widehat{C}, \tag{3}$$

where

$$\widehat{C} = \sum_{i=1}^{I}\left[\left(\frac{1}{h_{i+1}}\right)^{-\gamma_2} - \left(\frac{1}{h_i}\right)^{-\gamma_2}\right] c_i.$$

Geometric Brownian Motion Cash Flows



Parameters: $r = 0.06$, $\mu = 0.02$, $\sigma = 0.25$, $c_1 = 1.5$, $c_2 = 1$, $G = 2\%$.

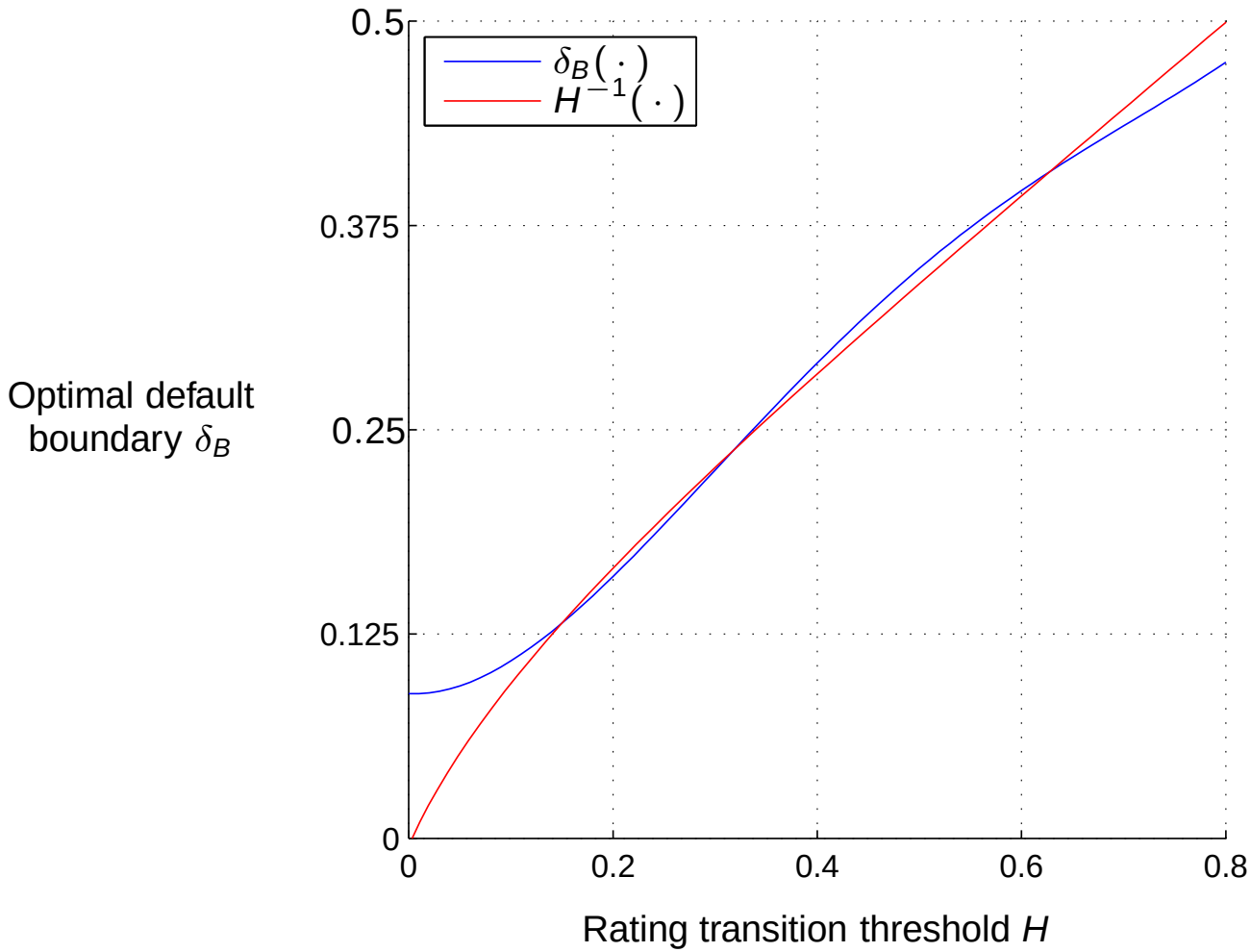
Mean-Reverting Cash Flows

Cash-flow process δ follows a mean-reverting process with proportional volatility:

$$d\delta_t = \lambda(\mu - \delta_t)dt + \sigma\delta_t dB_t \tag{4}$$

where λ is the speed of mean reversion, μ is the long-term mean earnings level to which δ reverts, and σ is the volatility.

Mean-Reverting Cash Flows



Paramters: $r = 0.06$, $\lambda = 0.15$, $\mu = 1$, $\sigma = 0.4$, $c_1 = 1.3$, $c_2 = 0.75$, $G = 21\%$.

Outline of the Talk

Comparative Statics

Proposition: The equilibrium default boundary δ_B and rating transition thresholds H associated with the tough-rating-agency equilibrium and the soft-rating-agency equilibrium are

1. increasing in the coupon payments C.
2. increasing in the interest rate r.
3. decreasing in the drift $\mu(\cdot)$ of the cash flow process.
4. decreasing in the target rating transition thresholds G.

Outline of the Talk

Conclusion

- Tractable model of credit ratings with feedback effects.
- Feedback effects lead to multiple equilibria, all with accurate ratings.
- Rating agencies should not only be concerned about accuracy, but also with the survival of the issuer (stress-tests vs issuer-pay model).
- Small shocks may lead to multi-notch downgrades or immediate default, even if the rating agency pursues an accurate rating policy.
- Competition between rating agencies may create downgrade pressure, increasing default frequency and reducing welfare.