

CoCos, Bail-In, and Tail Risk

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Views and opinions expressed are those of the authors and do not necessarily represent official OFR or Treasury positions or policy.

Overview

- Contingent convertibles (CoCos) and bail-in debt are two variants of debt that converts to equity when a bank gets in trouble
 - a built-in mechanism to increase capital when it is most needed and most difficult to raise
- They differ in the point of conversion and the dilution at conversion
 - CoCos: Going-concern contingent capital. High trigger, and pre-conversion shareholders continue to own part of the firm
 - Bail-In: Gone-concern contingent capital. Converts at point of non-viability, and previous shareholders are wiped out
- What are the incentive effects of CoCos and bail-in, and what drives these effects?

Questions

- Would equity holders ever voluntarily replace straight debt with CoCos?
- How does the (regulator's) trigger level for CoCos affect the optimal bankruptcy boundary for equity holders?
- How do CoCos affect debt overhang costs – the reluctance of equity holders to invest in a highly leveraged firm?
- How do CoCos affect asset substitution – the propensity of equity holders to choose riskier assets after issuing debt?
- How do CoCos compare with orderly resolution as solutions to too-big-to-fail?
- What if US banks had issued CoCos before the crisis?
- How do endogenous default, debt maturity, tax treatment, deposit insurance, bankruptcy costs, and tail risk influence the answers to these questions?

Related Research (Partial List)

- Flannery (2005,2009):
 - Proposed reverse convertible debentures, progressive conversion
- McDonald (2010), Squam Lake Working Group (2010)
 - Dual trigger: bank-specific and/or systemic
- Pennacchi (2010)
 - Jump-diffusion simulation model for valuation, incentives
- Albul, Jaffee, and Tchisty (2010); Hilscher and Raviv (2011)
 - Diffusion models, infinite-maturity/finite-maturity debt
- Sundaresan and Wang (2010)
 - Potential pitfalls of market triggers
- Pennacchi, Vermaelen, Wolf (2010)
 - Propose combination of CoCos with warrants
- Glasserman and Nouri (2010)
 - Valuation: progressive conversion, book-value trigger, pure diffusion

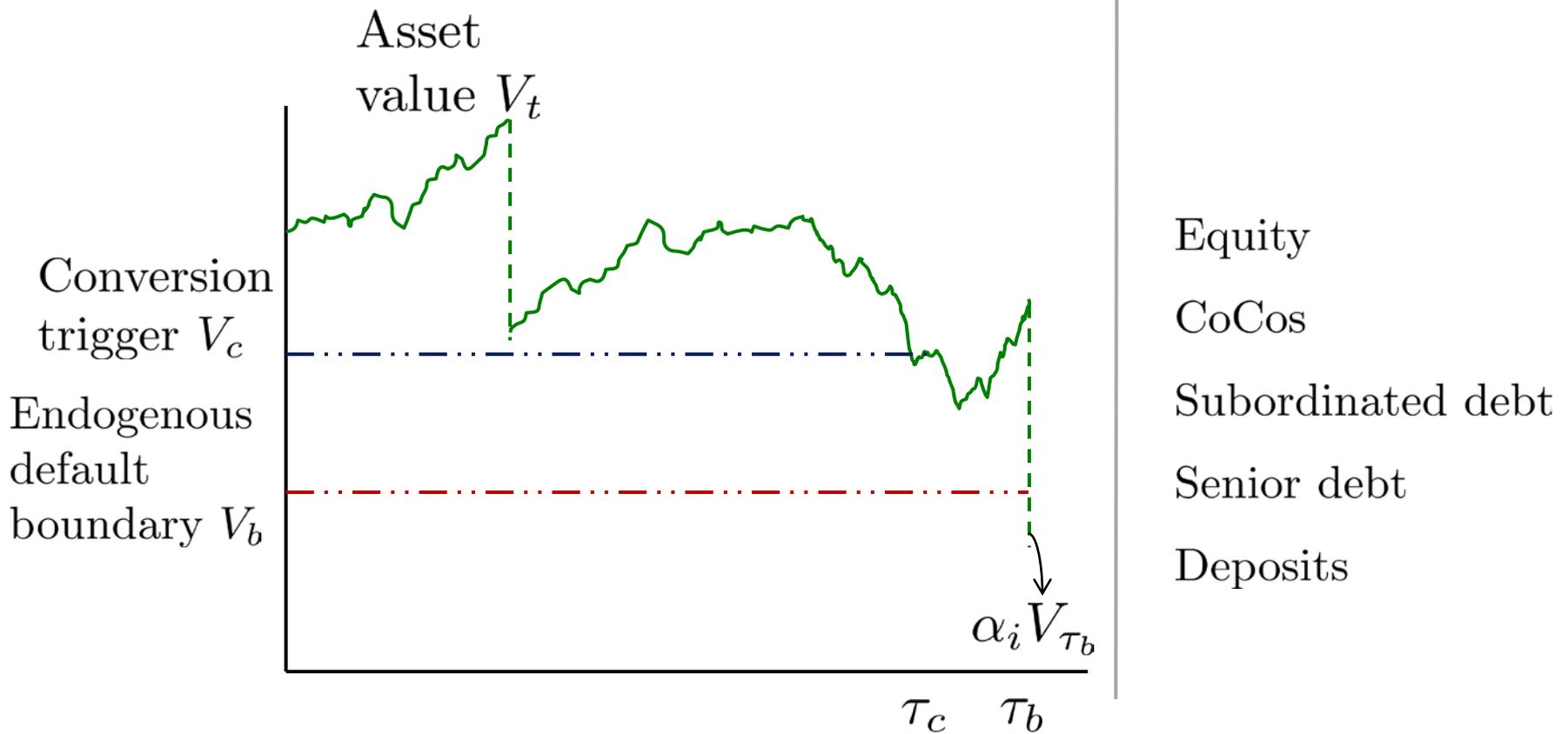
Overview of the Paper

- Jump-diffusion dynamic capital structure model and valuation
- Comparative statics and examples to address the incentive questions
- Calibration of the model to the largest US bank holding companies through the crisis

Key Contributions and Conclusions

- Our model combines
 - Endogenous default
 - Debt roll-over at various maturities and levels of seniority
 - Jumps and diffusion in cash flows and asset values
- Through these features, CoCos can create incentives for shareholders to
 - Reduce default risk (through capital structure and asset riskiness)
 - Invest in the firm to stave off conversion
 - Potentially take on additional tail risk

Schematic of the Model



Asset Value Process

$$\frac{dV_t}{V_{t-}} = (r - \delta) dt + \sigma dW_t + d \left(\sum_{i=1}^{N_t^f} (Y_i^f - 1) \right) + d \left(\sum_{j=1}^{N_t^m} (Y_j^m - 1) \right) - (\lambda^m + \lambda^f) \xi dt$$

- Payout rate δ
- Compound Poisson jump processes
- Exponential(η) distributed negative jumps – down jumps only
- Firm-specific (f) and market-wide (m) jumps
 - Market-wide jumps are rarer and more severe $\eta_f > \eta_m$
 - Lower recovery rate at default through market-wide jump because of fire sales
- Compensation for jump risk $\xi < 0$

Cash Flows and Default

Net Dividends = Inflows – Outflows

- When this is negative, equity holders are investing to keep the firm going – until optimal abandonment (default)

Inflows

- Assets generate cash at rate δV_t
- Issuance of debt generates cash:
 - Leland-Toft (1996) maturity structure for each type of debt
 - Debt issued at constant par value, but the cash raised is determined by the market value of debt

Outflows

- After-tax coupon payments [CoCos or not]
- Deposit insurance fees on assessed base [CoCos or not]

Key link between default, debt roll-over, and incentives for shareholders

Replacing Straight Debt With CoCos

- Would shareholders ever do this voluntarily?
 - No, in earlier models: pure diffusion with single debt maturity

In our model, two competing effects:

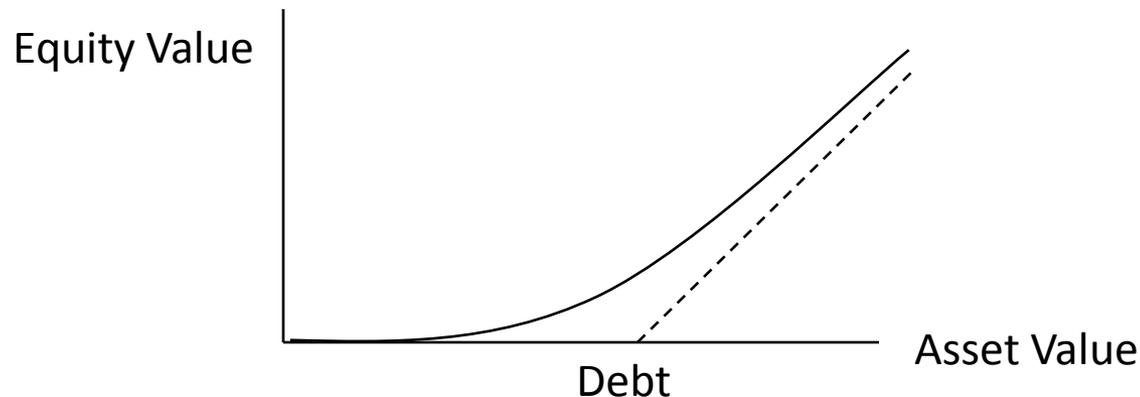
- The replacement reduces firm value by reducing the value of the debt tax shield, especially (but not only) if CoCo coupons are not deductible
- CoCos lower debt service cost after conversion, increasing dividends to shareholders; this lowers the optimal default barrier, thus reducing bankruptcy cost and increasing firm value

Numerically, we find that the second effect dominates: shareholders have a positive incentive to make the substitution

[Note incentive effects of tax and insurance assessment treatment of CoCos]

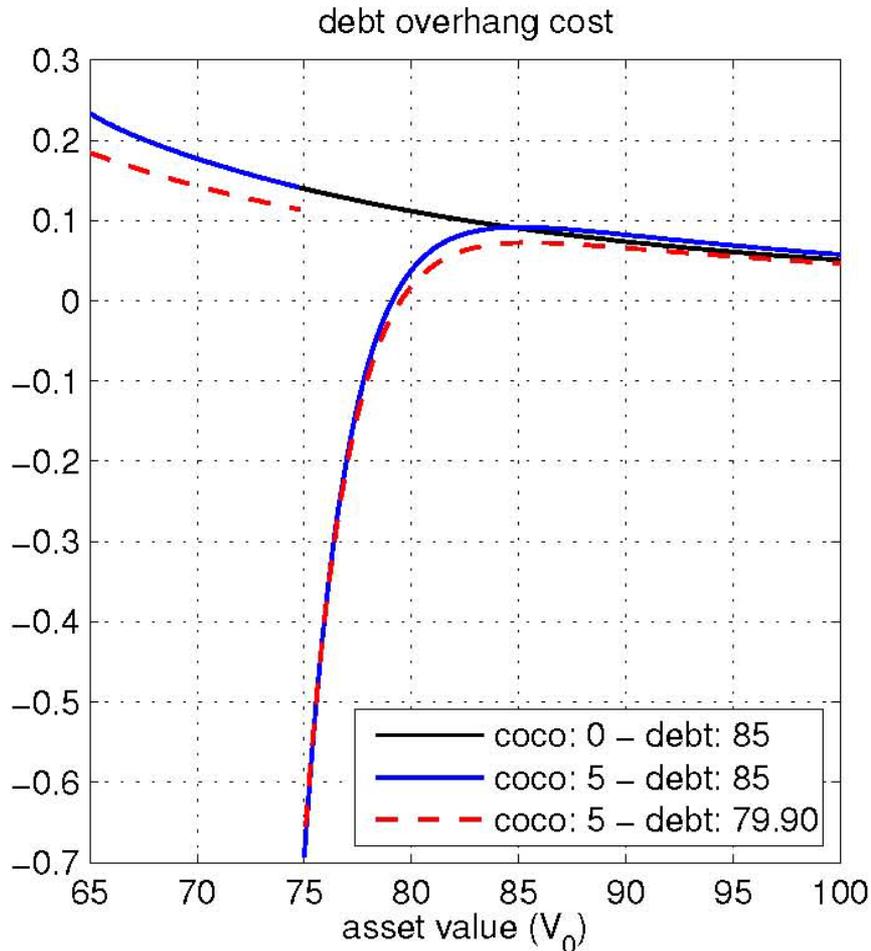
Debt Overhang Costs

- Debt overhang (Myers 1977): Equity holders are unwilling to invest in a firm nearing bankruptcy because most of the value of their investment goes to creditors
- Debt overhang cost is always positive in a Merton-style model of equity as a call option on assets



- With debt roll-over, the reduction in default risk benefits shareholders by reducing roll-over costs. What about CoCos?

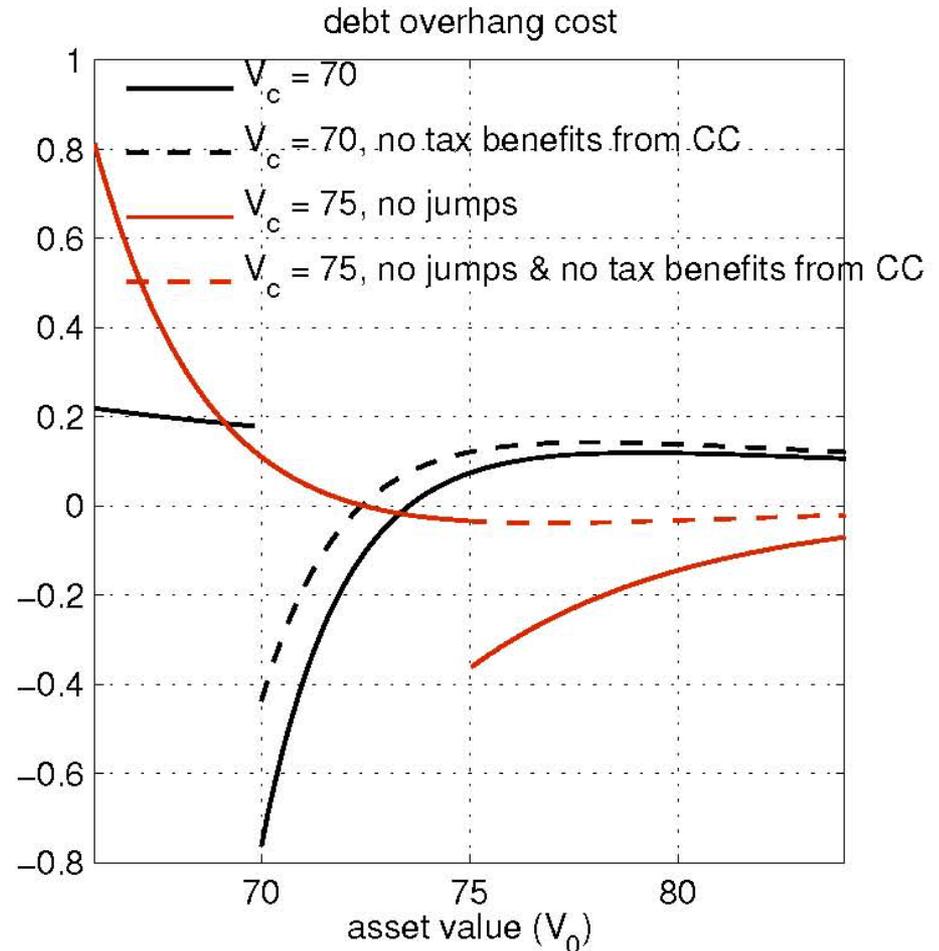
Debt Overhang Cost



- Overhang cost = investment – change in equity value
- Conversion trigger = 75
- Without CoCos, overhang cost increases as asset value decreases
- Below the trigger, CoCos are irrelevant
- Good news: Overhang cost becomes very negative as asset value approaches the trigger and equity holders try to stave off conversion
- This is an important incentive effect

Debt Overhang Cost: A Closer Look

- Removing tax deductibility of CoCo coupons reduces investment incentive (solid vs. dashed lines)
- Bad news: Removing jumps in asset value removes about half the investment incentive
- Equity holders would rather blow up than convert at the trigger



How Should the Conversion Ratio Be Set?

Two types of arguments

- Conversion ratio should be punitive to existing shareholders to encourage capital injection and reduce risk-taking
- CoCo spreads should widen as the firm approaches conversion to provide a signal to the market (like sub debt)
 - A conversion that's too attractive to CoCo investors creates the risk of a “death spiral”

How Should the Conversion Ratio Be Set?

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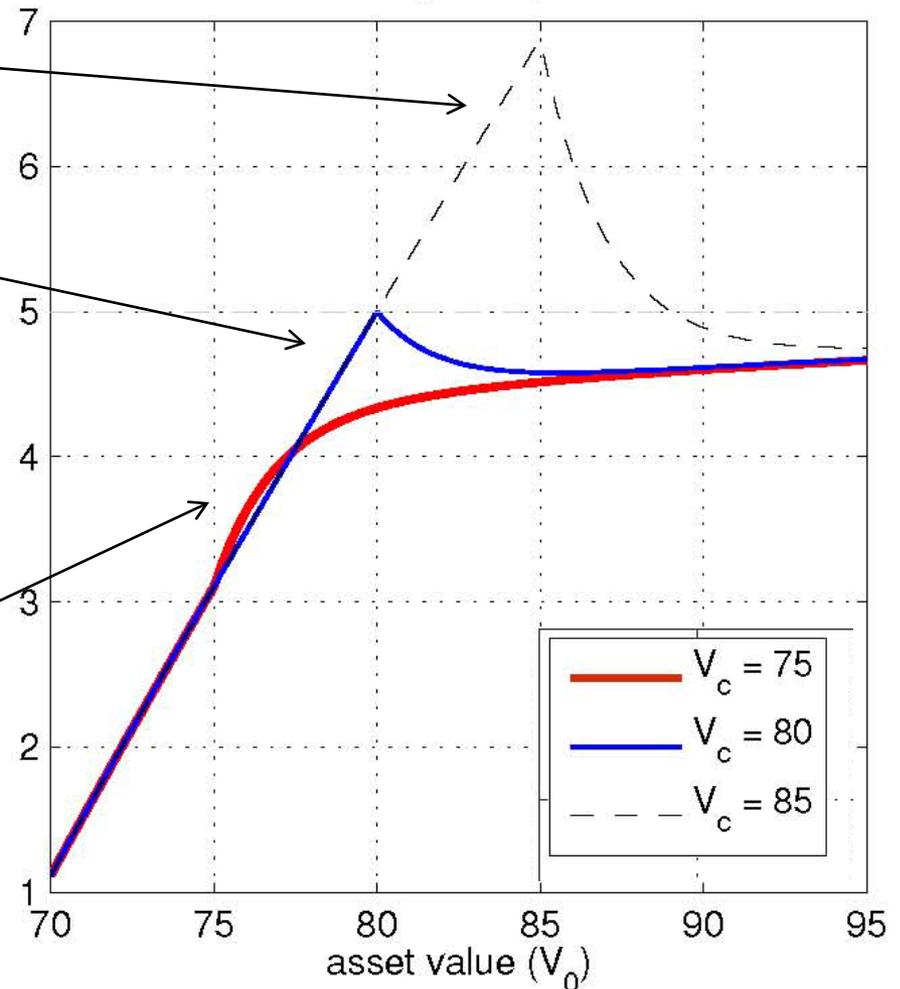
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These objectives are mutually exclusive!

More fundamentally, prices are continuous at conversion in any valuation model consistent with rational expectations – need to be careful about incentive effects

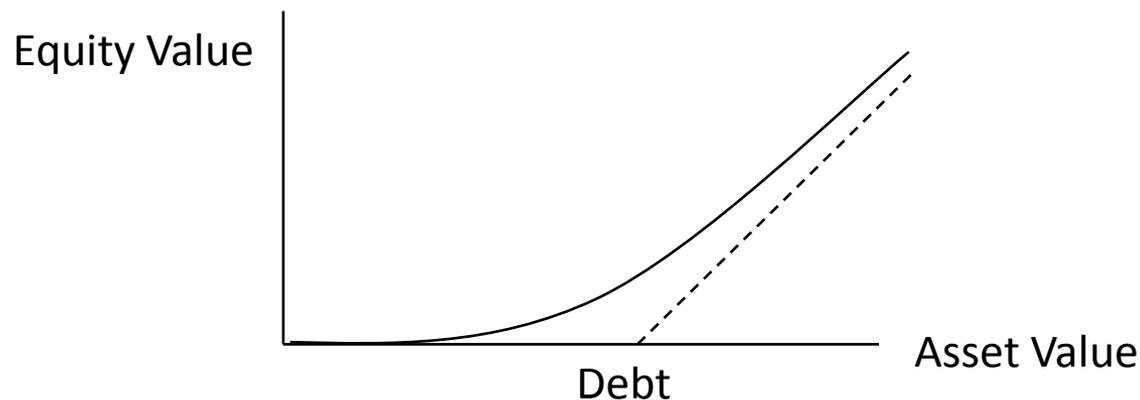
CoCo Price Near Conversion

- Conversion at 85 is punitive to shareholders – CoCo spread narrows near conversion
- Conversion ratio is set to be “fair” if conversion is at 80: market value of shares = par value of CoCos
- Conversion at 75 (favorable to shareholders) causes CoCo spread to widen near conversion



Asset Substitution

- After equity holders issue debt, they (may) have an incentive to increase the riskiness of the assets
- This is always true in a Merton-style model of equity as a call option on assets – option value increases with volatility



- With debt roll-over, a reduction in default risk benefits shareholders by reducing roll-over costs. What about CoCos?
- Need to consider jumps vs. diffusion and the effect of debt maturity

Asset Substitution

- As in a Merton model, equity holders capture the upside
 - This encourages more risk
- Riskier assets increase debt rollover costs
 - This argues for less risk, particularly with shorter-maturity debt
- With CoCos, conversion leads to (partial) loss of tax shield
 - This argues for less risk
- Shareholders prefer conversion at a low asset level rather than a high asset level
 - This argues for less diffusion risk and more jump risk

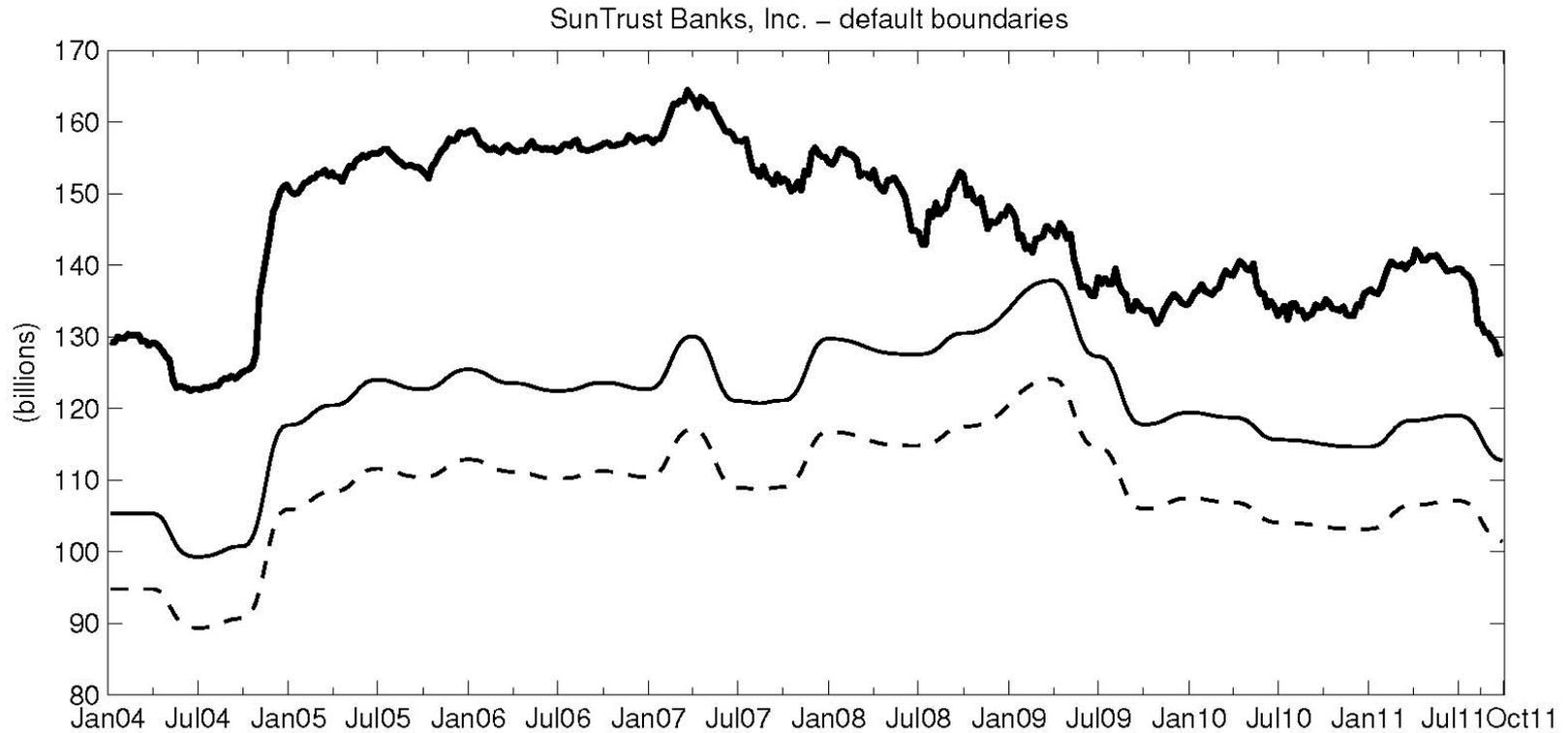
Calibration to Banks During the Crisis

- Take 19 largest US bank holding companies; drop MetLife and Ally/GMAC
- Inputs
 - Market value of equity
 - Quarterly reports for deposits, short-term debt, long-term debt
 - Interest payments and dividends for payout rate
 - Risk-free rate: Treasury yield at weighted average maturity of debt
 - FISD and TRACE for market yields on debt
- Calibration
 - Need market value of assets, but this is not observable
 - We use a model-implied asset process
 - We need risk-neutral parameters of asset value process

Calibration of Asset Value Parameters

	Parameters		
	λ	η	σ
Bank Holding Company			
Bank of America Corp	0.1	5	4.1%
JPMorgan Chase & Co.	0.1	8	4.4%
Citigroup Inc.	0.1	9	3.9%
Wells Fargo & Company	0.1	5	4.7%
Goldman Sachs Group, Inc.	0.1	5	3.8%
Morgan Stanley	0.1	8	4.2%
PNC Financial Services	0.3	8	7.0%
U.S. Bancorp	0.3	5	5.5%
Bank of New York Mellon Corp.	0.3	6	7.3%
SunTrust Banks, Inc.	0.3	9	4.1%
Capital One Financial Corp.	0.3	7	7.9%
BB&T Corporation	0.3	6	5.3%
Regions Financial Corporation	0.3	8	4.7%
State Street Corporation	0.3	5	7.4%
American Express Company	0.3	8	8.6%
Fifth Third Bancorp	0.3	5	6.3%
KeyCorp	0.3	8	4.2%

Example: SunTrust Assets and Default Boundaries

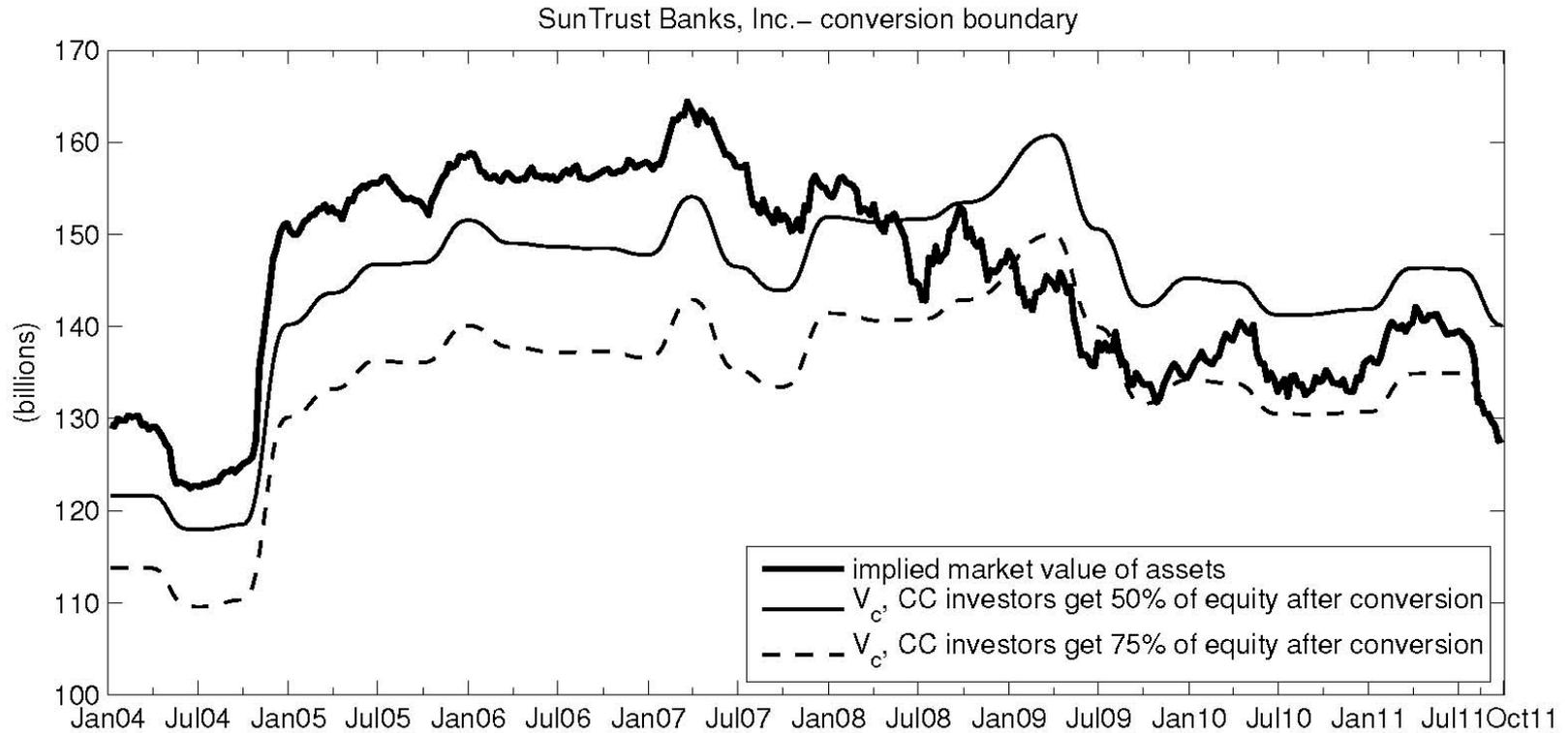


- Asset value (top)
- No-CoCo default boundary (middle)
- With-CoCo default boundary (bottom)

Loss Absorption/CoCo Size and Distance to Default

	Jan-2006		Jan-2007		Jan-2008		Jan-2009	
Bank of America Corp	1.47	7%	1.43	8%	1.63	5%	1.54	3%
JPMorgan Chase & Co.	1.29	6%	1.29	6%	1.49	5%	1.50	5%
Citigroup Inc.	1.34	7%	1.32	6%	1.42	4%	-	2%
Wells Fargo & Company	1.11	19%	1.06	22%	1.44	9%	1.60	5%
Goldman Sachs Group, Inc.	1.35	4%	1.41	5%	1.52	4%	-	4%
Morgan Stanley	1.43	4%	1.38	4%	1.50	5%	-	5%
PNC Financial Services	1.17	19%	1.11	21%	1.29	14%	-	8%
U.S. Bancorp	0.95	32%	0.98	32%	1.11	24%	1.17	18%
Bank of New York Mellon	1.15	24%	1.06	28%	1.04	28%	0.80	17%
SunTrust Banks, Inc.	0.91	21%	0.87	22%	0.91	16%	-	8%
Capital One Financial Corp.	0.93	29%	0.92	26%	0.97	16%	-	12%
BB&T Corporation	1.03	25%	1.03	23%	0.97	14%	-	9%
Regions Financial Corp.	0.90	24%	0.89	19%	0.87	12%	-	4%
State Street Corporation	1.33	18%	1.25	20%	1.07	24%	-	11%
American Express Company	1.15	38%	1.13	36%	1.26	28%	1.50	18%
Fifth Third Bancorp	0.89	26%	0.77	31%	-	17%	-	6%
KeyCorp	1.11	17%	1.01	20%	-	10%	-	5%
mean	1.15	18.81%	1.11	19.23%	1.23	13.73%	1.35	8.15%
median	1.15	19.32%	1.06	20.52%	1.26	13.80%	1.50	5.81%

SunTrust Conversion Triggers

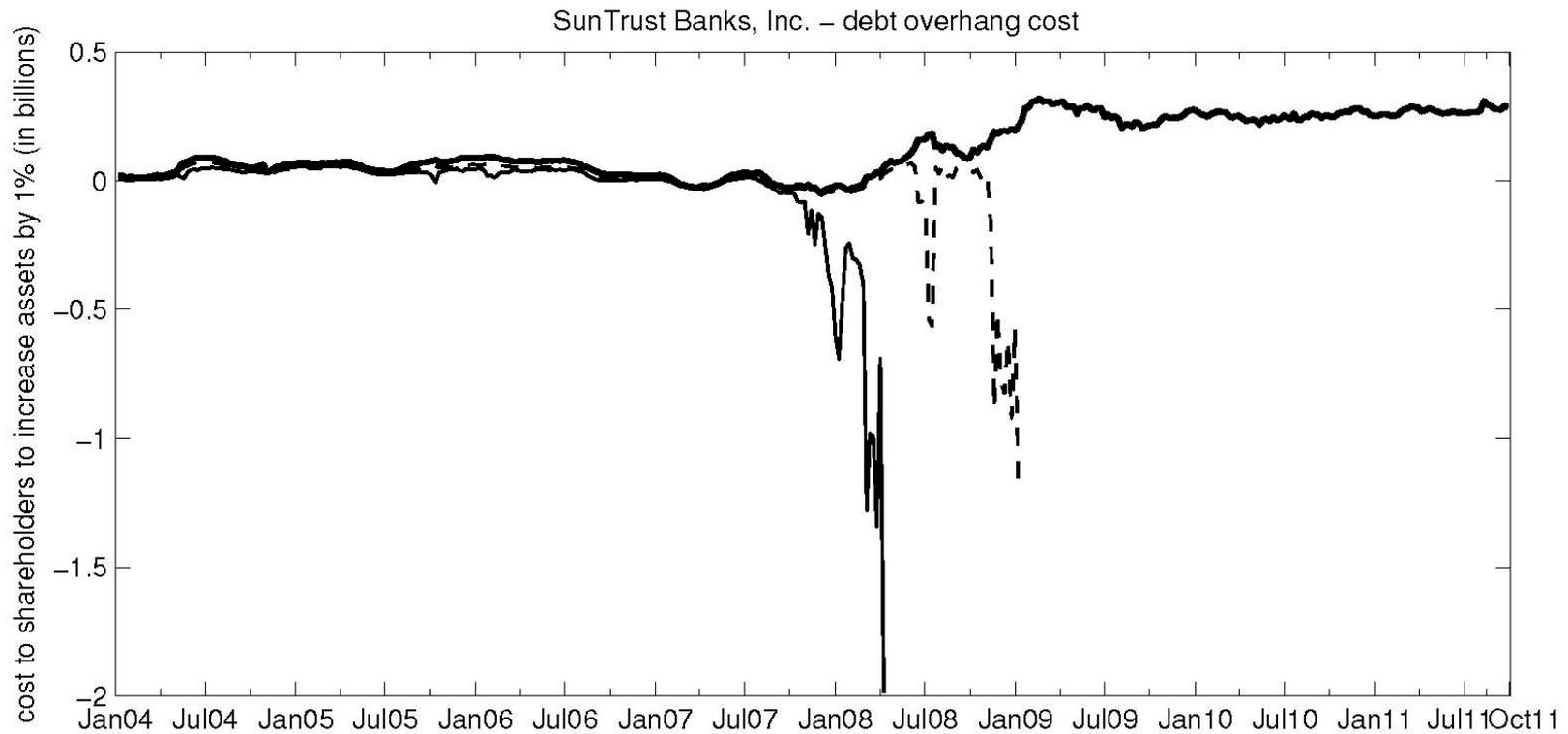


- Asset value
- Conversion trigger with 50% dilution
- Conversion trigger with 75% dilution

Conversion Dates

Bank Holding Company	Parameters			Conversion Date	
	λ	η	σ	50%	75%
Bank of America Corp	0.1	5	4.1%	Jan-09	
JPMorgan Chase & Co.	0.1	8	4.4%		
Citigroup Inc.	0.1	9	3.9%	Nov-08	
Wells Fargo & Company	0.1	5	4.7%		
Goldman Sachs Group, Inc.	0.1	5	3.8%	Nov-08	
Morgan Stanley	0.1	8	4.2%	Sep-08	Dec-08
PNC Financial Services	0.3	8	7.0%	Nov-08	Jan-09
U.S. Bancorp	0.3	5	5.5%	Jan-09	
Bank of New York Mellon Corp.	0.3	6	7.3%	Oct-08	
SunTrust Banks, Inc.	0.3	9	4.1%	Apr-08	Jan-09
Capital One Financial Corp.	0.3	7	7.9%	Jun-08	Jan-09
BB&T Corporation	0.3	6	5.3%	Jun-08	
Regions Financial Corporation	0.3	8	4.7%	Jun-08	Jan-09
State Street Corporation	0.3	5	7.4%	Oct-08	
American Express Company	0.3	8	8.6%		
Fifth Third Bancorp	0.3	5	6.3%	Jan-08	Jun-08
KeyCorp	0.3	8	4.2%	Nov-07	Nov-08

SunTrust Debt Overhang Cost



- Cost to increase asset value by 1%
- Drops sharply (becoming negative) near conversion

Debt Overhang Cost Without/With CoCos and Distance to Conversion

	Feb-2008			Apr-2008			Aug-2008		
⇒ Bank of America Corp	-29%	-32%	6%	-26%	-30%	5%	-28%	-42%	3%
JPMorgan Chase & Co.	-75%	-51%	5%	-43%	-41%	5%	-93%	-60%	3%
⇒ Citigroup Inc.	-42%	-53%	3%	-24%	-45%	2%	-54%	-65%	2%
Wells Fargo & Company	-35%	-23%	8%	-33%	-20%	8%	-33%	-21%	7%
Goldman Sachs Group	-51%	-45%	2%	-33%	-42%	2%	-53%	-54%	2%
⇒ Morgan Stanley	21%	-42%	1%	21%	-36%	1%	-20%	-58%	2%
⇒ PNC Financial Services	-11%	-16%	7%	-7%	-12%	8%	-10%	-12%	8%
U.S. Bancorp	4%	4%	13%	5%	5%	13%	5%	5%	11%
Bank of New York Mellon	-3%	-2%	17%	-1%	0%	14%	6%	4%	8%
⇒ SunTrust Banks, Inc.	-2%	-20%	2%	5%	-	-	9%	-	-
⇒ Capital One Financial	-4%	-28%	3%	4%	-34%	2%	6%	-	-
⇒ BB&T Corporation	2%	-11%	4%	4%	-12%	4%	6%	-60%	1%
⇒ Regions Financial Corp.	-7%	-24%	3%	-8%	-42%	2%	-9%	-	-
⇒ State Street Corporation	2%	2%	11%	5%	-1%	6%	0%	-11%	5%
⇒ American Express Co.	-12%	-13%	20%	-7%	-10%	20%	-10%	-12%	17%
⇒ Fifth Third Bancorp	12%	-79%	0%	17%	-	-	19%	-	-
⇒ KeyCorp	-6%	-137%	0%	-1%	-	-	5%	-	-

Summary and Concluding Remarks

- We've developed a jump-diffusion capital structure model to value contingent capital in the form of CoCos and bail-in debt
- Key model features include endogenous default, debt rollover and jumps
- Main observations
 - Because equity holders capture some of the benefit of reduced bankruptcy costs, they often have a positive incentive to issue CoCos
 - CoCos reduce debt overhang costs near conversion
 - Reduce appetite for asset volatility, but can increase appeal of tail risk
 - Trigger needs to be high enough to ensure conversion before default
 - Calibration to bank data suggests that CoCos would have had positive effects through the crisis
- Effects are mainly driven by interaction of tax shield, debt maturity, bankruptcy costs

Thank You