Contingent Capital, Tail Risk, and Debt-Induced Collapse

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Overview

- Contingent convertibles (CoCos) are 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
  - A promising solution to the problem of banks too big to fail
  - Major issuances by Lloyds, Credit Suisse, and BBVA
  - More interest in Europe than the U.S.

- What are the incentive effects of CoCos (and bail-in debt), and what drives these effects?

- To address this question, we need to understand how CoCos affect endogenous default

Questions About Incentives

- How does the 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 as its assets lose value?

- How do CoCos affect asset substitution – the propensity of equity holders to choose riskier assets after issuing debt?

- How do endogenous default, debt maturity, tax treatment, bankruptcy costs, and tail risk influence the answers to these questions?

# Related Research (Partial List)

- Flannery (2005,2009):
  - Proposed reverse convertible debentures with a market trigger
- Albul, Jaffee, and Tchistyi (2010); Hilscher and Raviv (2011); Himmelberg and Tsyplakov (2012)
  - Diffusion models, infinite-maturity/single-maturity debt
- Pennacchi (2010)
  - Jump-diffusion simulation model, incentives, exogenous default
- McDonald (2010), Squam Lake Working Group (2010)
  - Dual trigger: bank-specific and/or systemic
- Sundaresan and Wang (2011), Glasserman and Nouri (2012)
  - Viability of market triggers

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

- These positive features rely on avoiding *debt-induced collapse*

Schematic of the Model

Equity and debt valued as contingent claims on underlying asset value
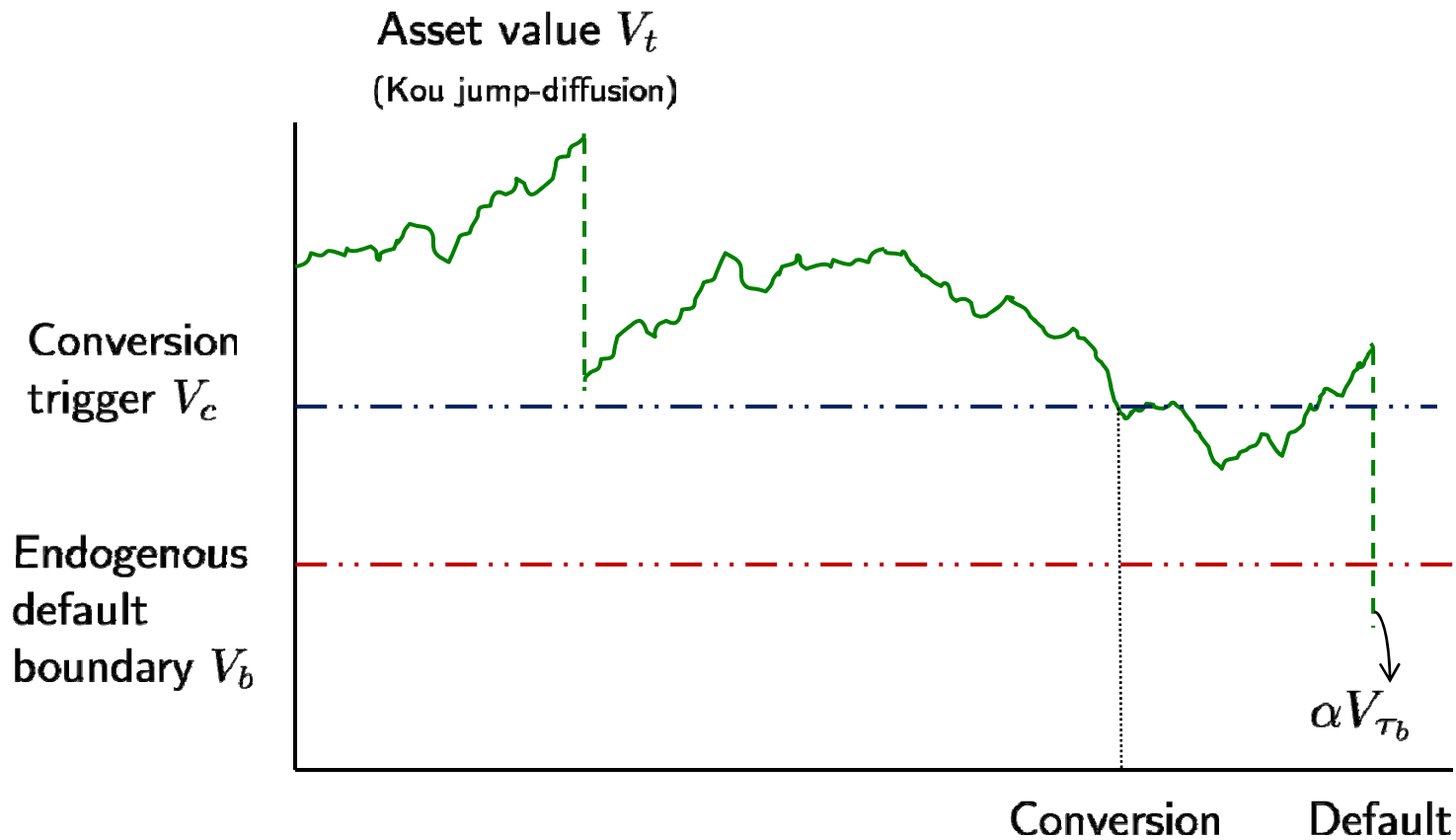
Schematic of the Model

- Equity and debt valued as contingent claims on underlying asset value
- At conversion, CoCo investors get a fixed number of shares
- For the original shareholders, conversion means
  - Eliminating some debt
  - But also diluting their shares

- (In the bail-in case, conversion coincides with default and the original shareholders are wiped out.)
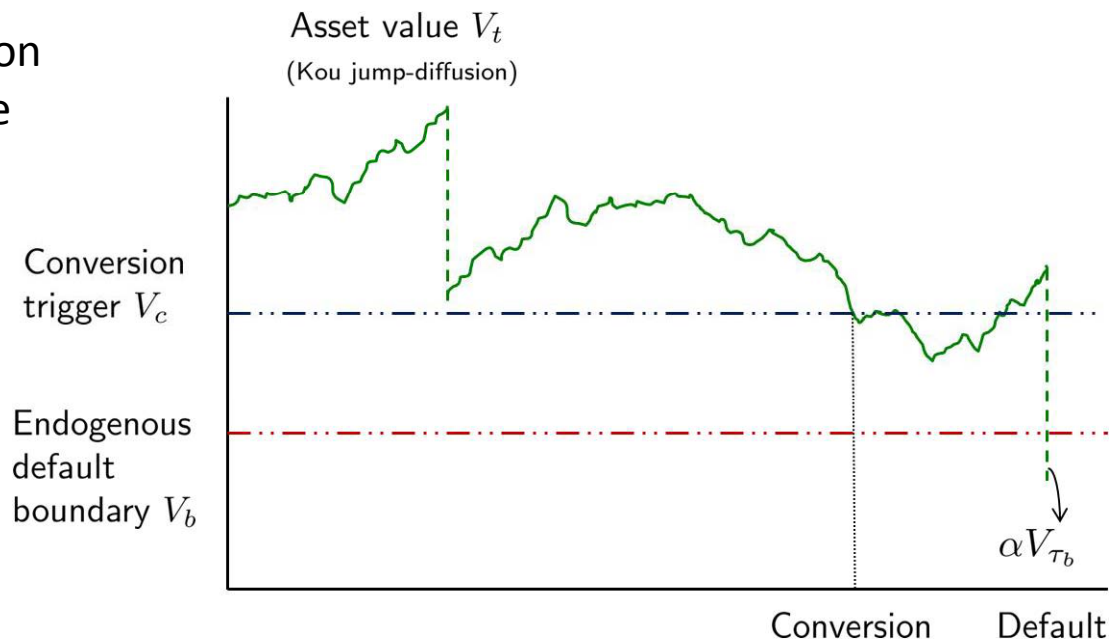
Asset value V_t
(Kou jump-diffusion)

Conversion trigger V_c

Endogenous default boundary V_b

αV_{τ_b}

Conversion   Default

In the Beginning…

- Black-Scholes (1973), Merton (1974): equity as a call, debt as a put on firm assets
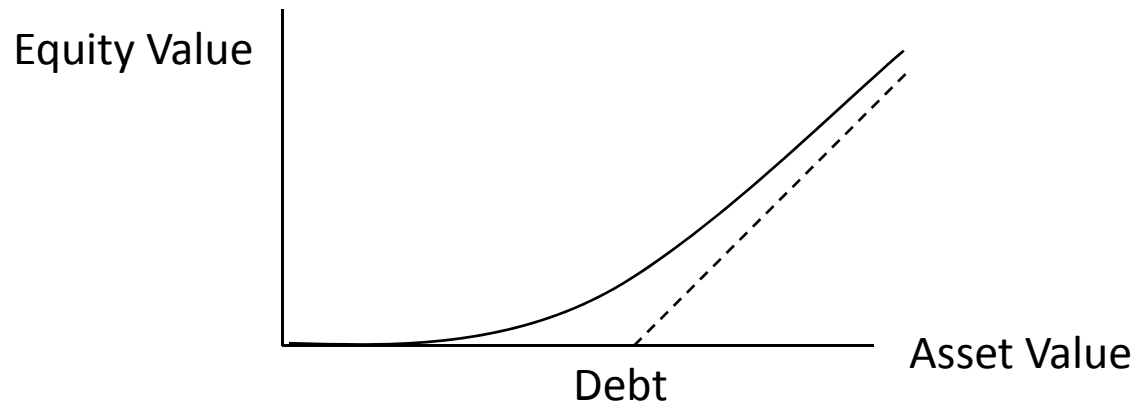
In the Beginning…

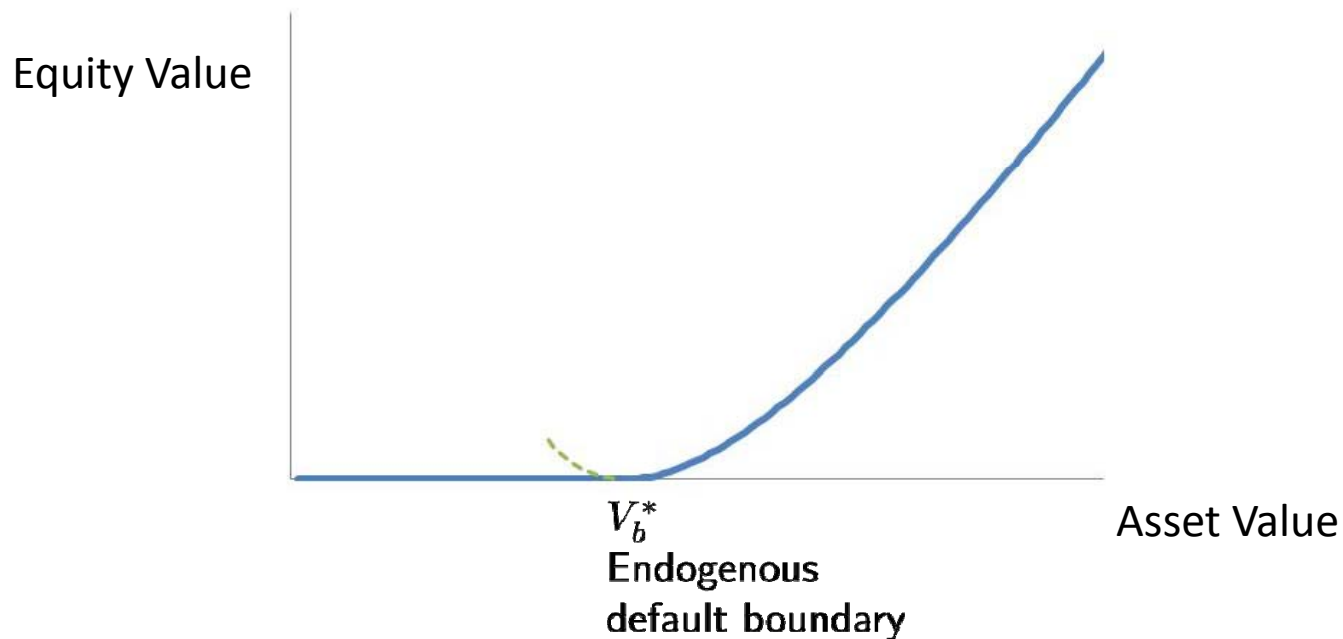- Black-Scholes (1973), Merton (1974): equity as a call, debt as a put on firm assets
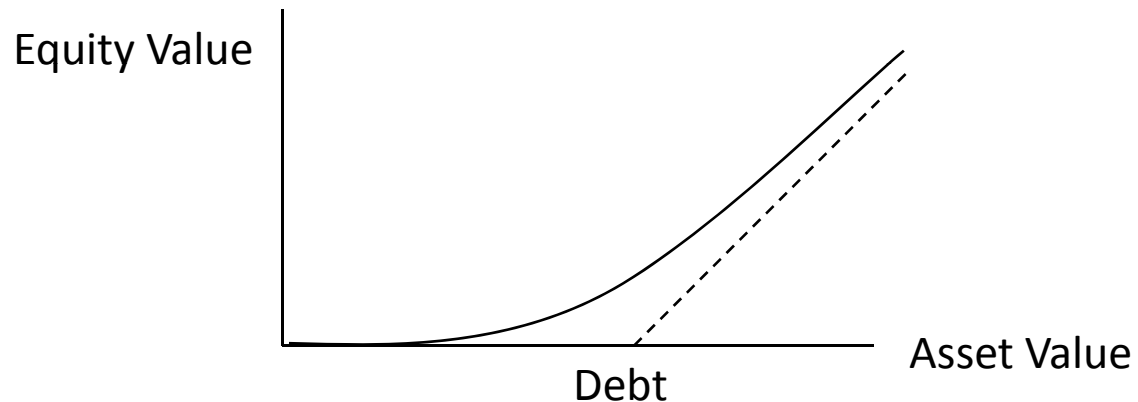
Implications
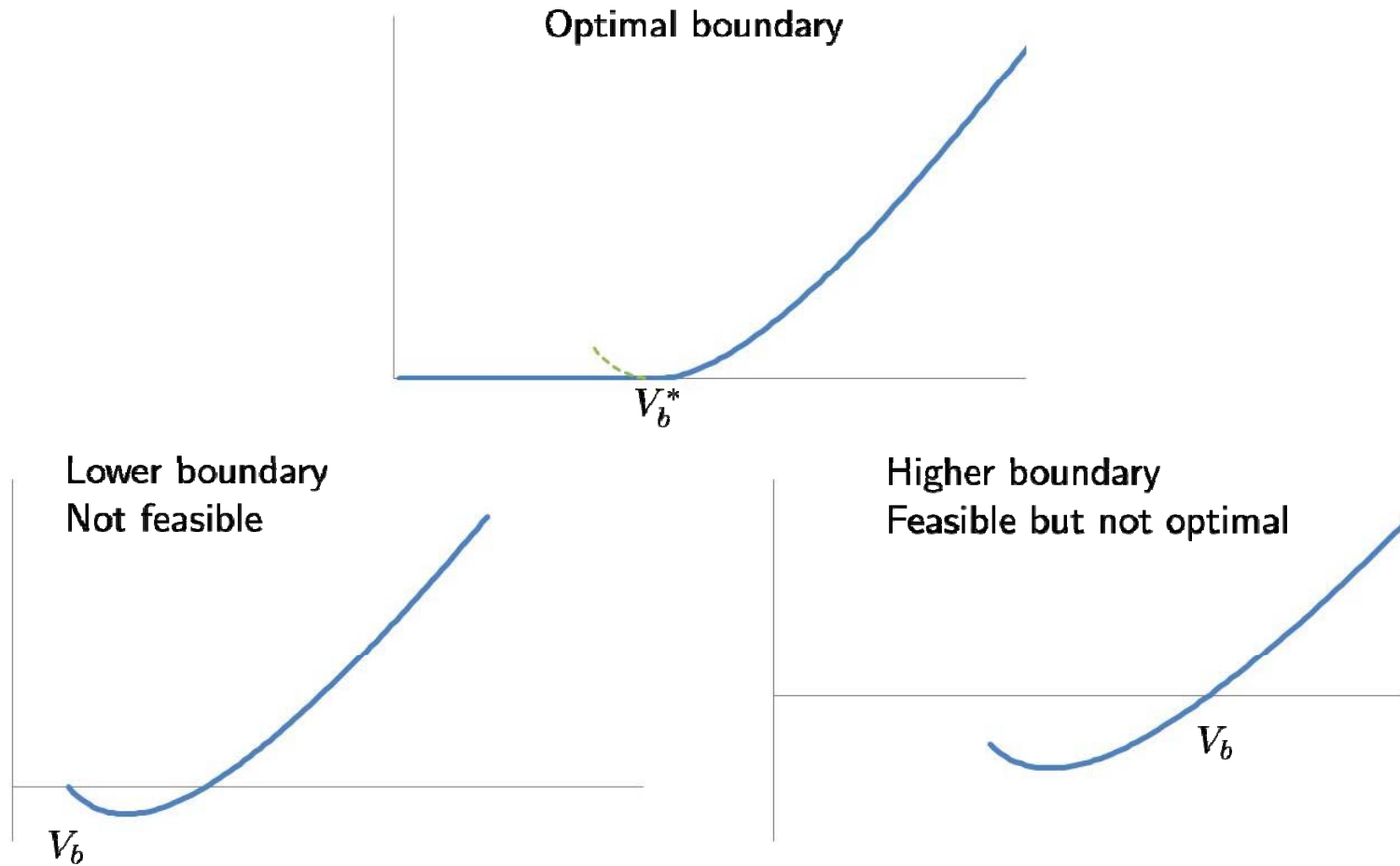- Debt overhang (Myers 1977) because Delta < 1
- Asset substitution (Jensen and Meckling 1976) because Vega>0

Endogenous Default

- Leland (1994):
  - Infinite horizon, perpetual debt, tax benefit of debt, bankruptcy costs
  - Shareholders choose default boundary to maximize equity value

Equity Value

V_b^*
Endogenous
default boundary

Asset Value

Default Boundary in Leland (1994)

Optimal boundary

V_b^*

Lower boundary
Not feasible

V_b

Higher boundary
Feasible but not optimal

V_b

Endogenous Default with CoCos

- Asset value follows Kou jump-diffusion model (exponential jumps)
- Debt maturity has an exponential profile (Leland-Toft '96, Chen-Kou '09)

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Theorem 1. For a firm with straight debt and with CoCos that convert at V_c, the optimal default barrier V_b^* has the following property: Either

$$V_b^* = V_b^{\mathsf{PC}} \leq V_c \quad \text{or} \quad V_b^* = V_b^{\mathsf{NC}} \geq V_c.$$
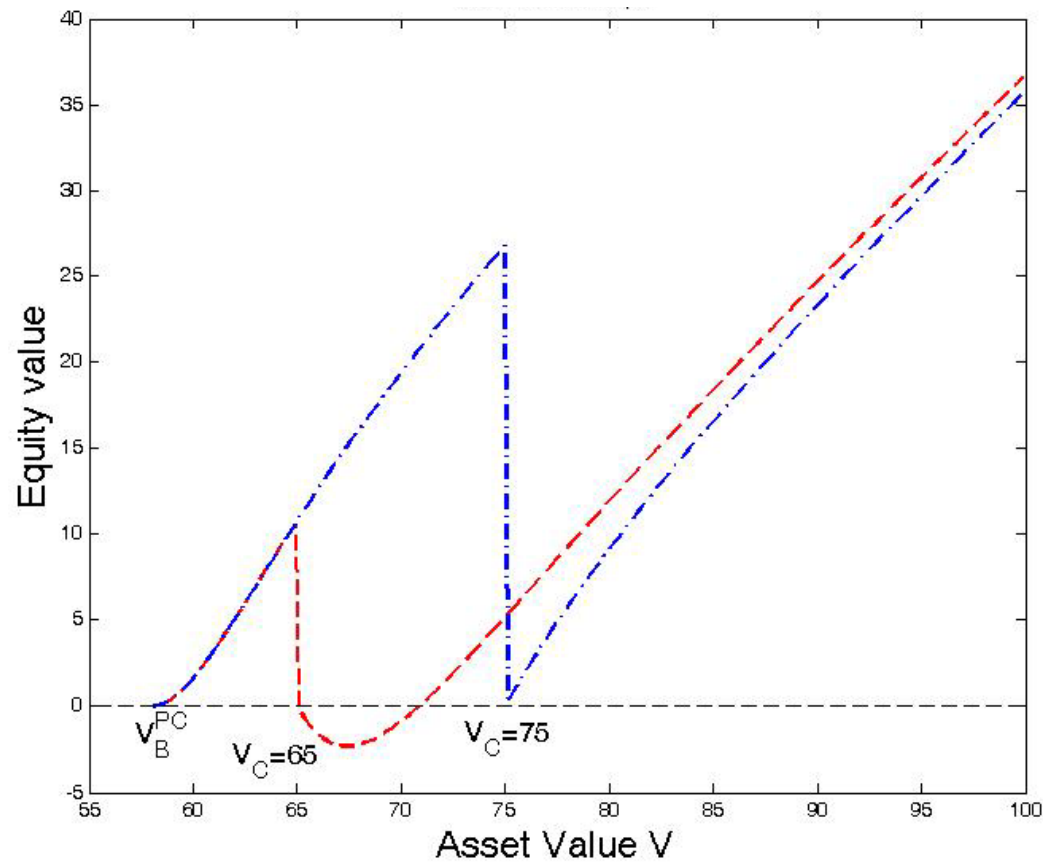
Moreover, V_b^{PC} is optimal whenever it is feasible, meaning that it preserves the limited liability of equity.

- An increase in either type of debt can move the firm from the first regime to the second, a phenomenon we call *debt-induced collapse*
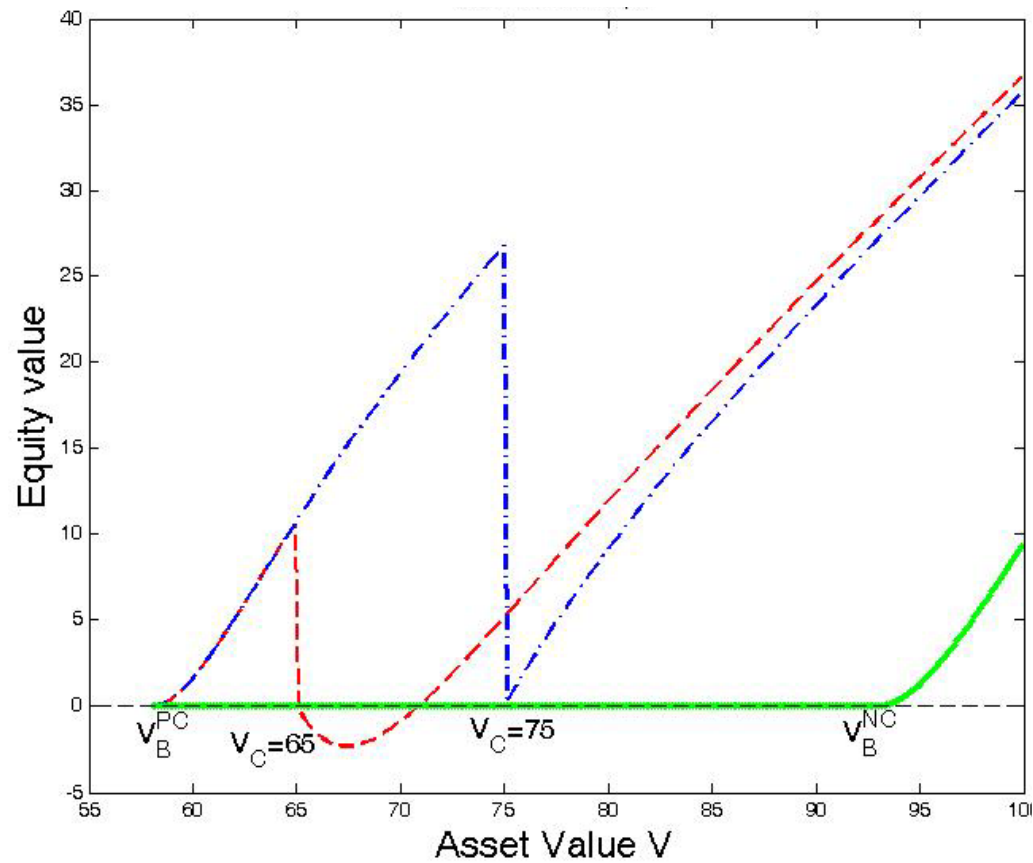
Equity Value and Default: Good Case
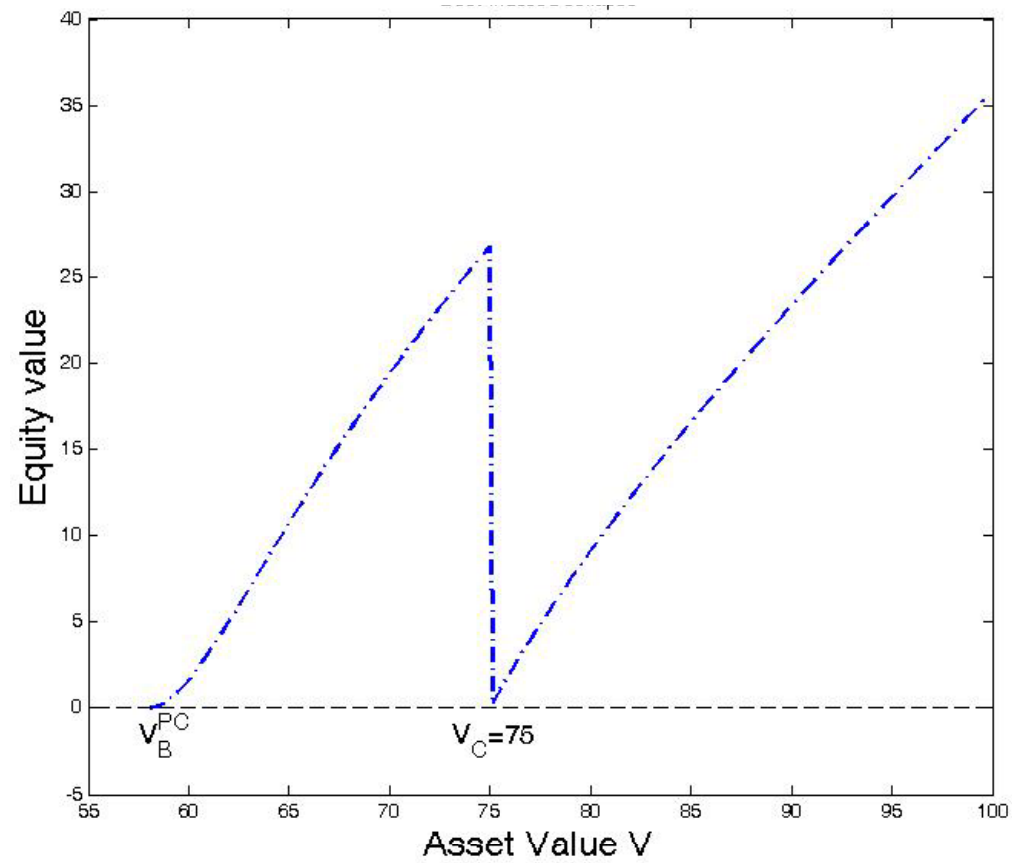
Equity Value and Default: Lower Conversion Trigger
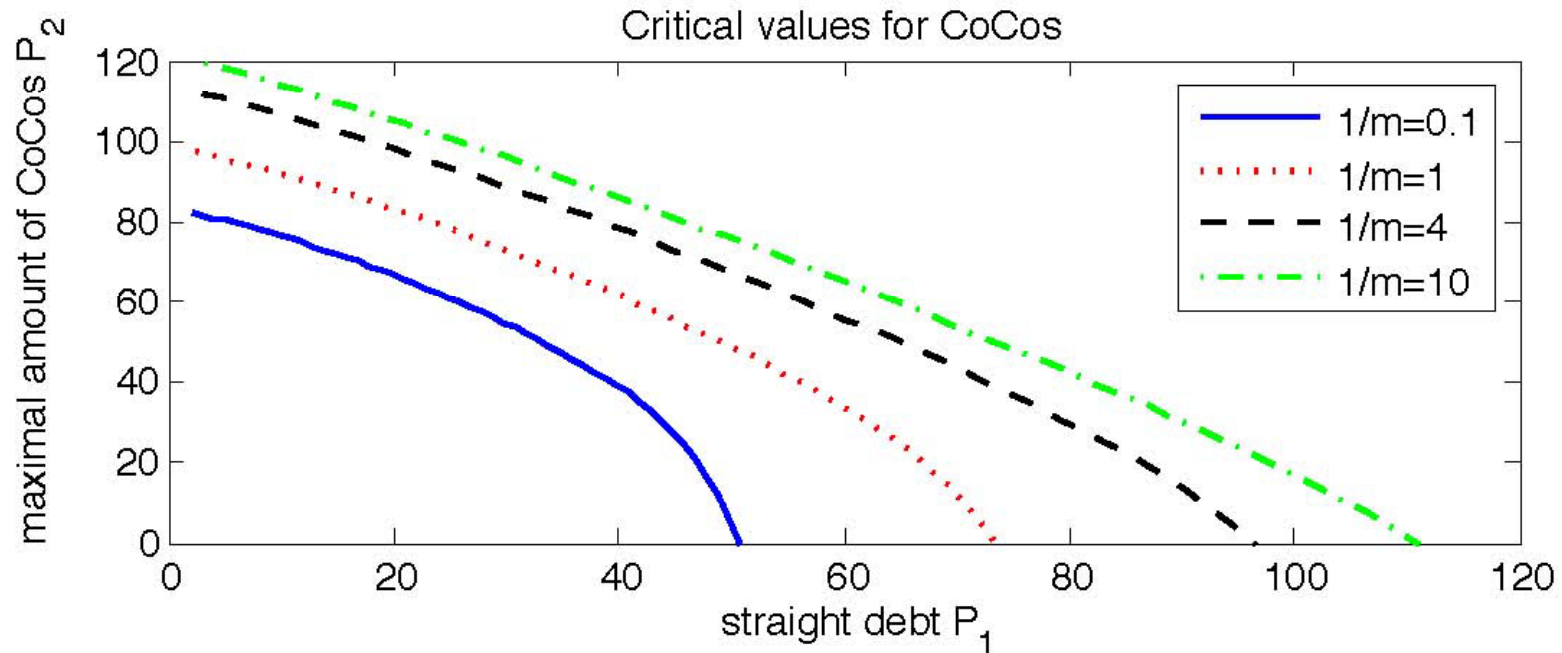
Debt-Induced Collapse

Equity value jumps down, default risk jumps up

Before Conversion, Post-Conversion, No-Conversion

- We are interested in the default boundary for the before-conversion firm
- Once the CoCos convert (PC), we will be dealing with a conventional capital structure for which we know the default boundary V_b^{PC}
- Anticipating this situation, the BC equity holders choose the PC boundary
- *But this choice may not be feasible!*

- In which case they will choose to default before conversion

- The optimal default boundary is then the no-conversion barrier – the default level that would be chosen if the CoCos were replaced by straight debt, causing debt-induced collapse

- *Need to set the conversion trigger high enough relative to total debt*

# Critical Levels of Debt for Debt-Induced Collapse

- 1/m = average debt maturity (in years)
- Total assets = 100

Incentive Effects

- By setting the conversion trigger sufficiently high (relative to total debt), we avoid debt-induced collapse, and the CoCos function as intended

- We can now look at incentive effects in the "good" regime

- The effects depend on the interaction between debt maturity, CoCos, and tail risk in the form of jumps
  - In particular, debt rollover allows shareholders to capture some of the benefit of reducing risk, all of which goes to bond holders in a model with a single debt maturity
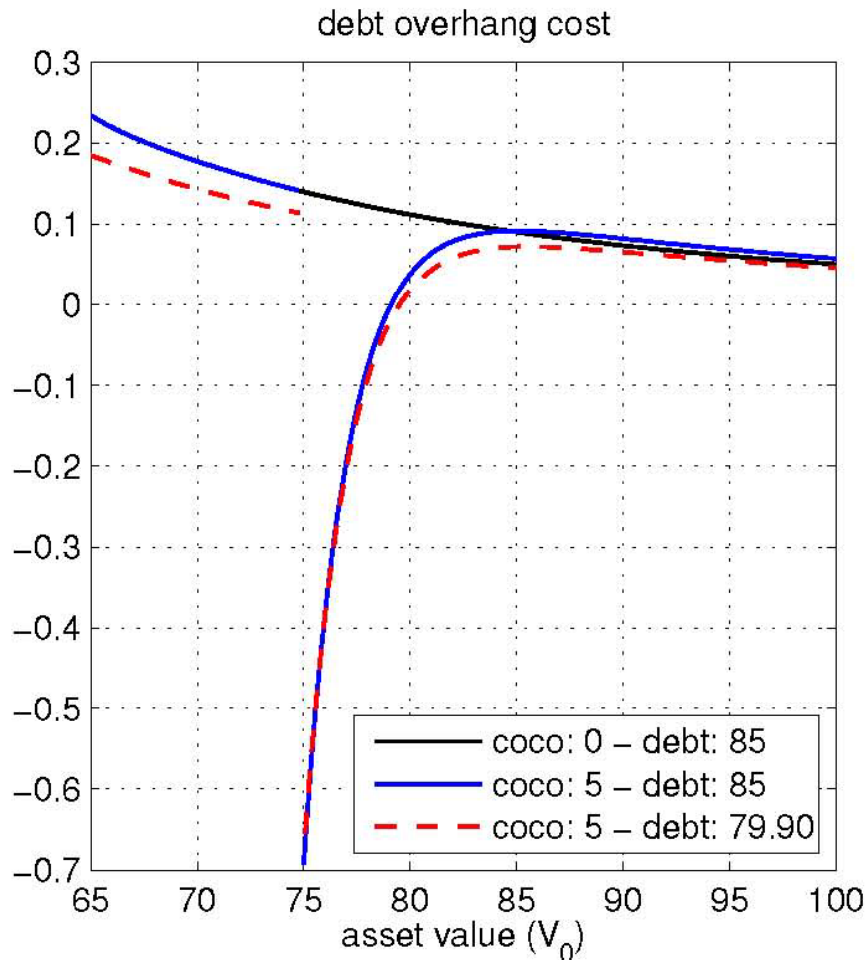
Debt Overhang Costs

- 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 Black-Scholes-Merton-style model
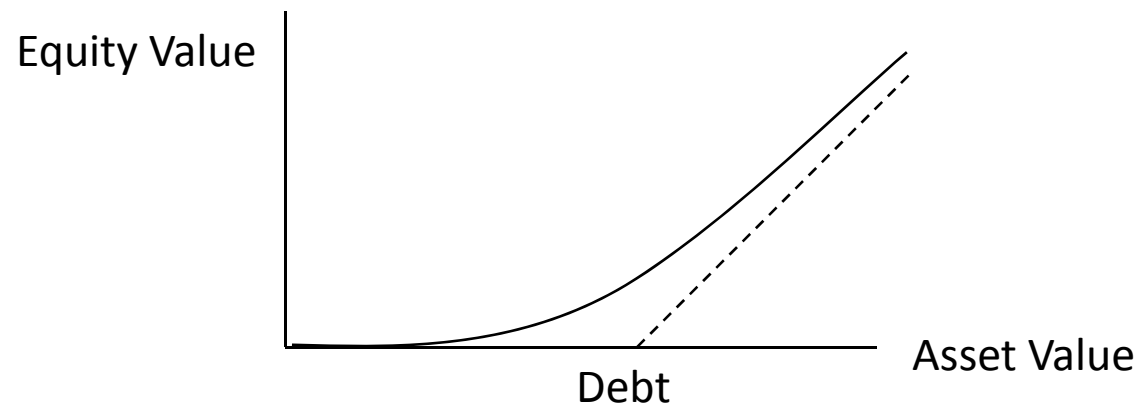
- With debt roll-over, the reduction in default risk benefits shareholders by reducing roll-over costs. What about CoCos?
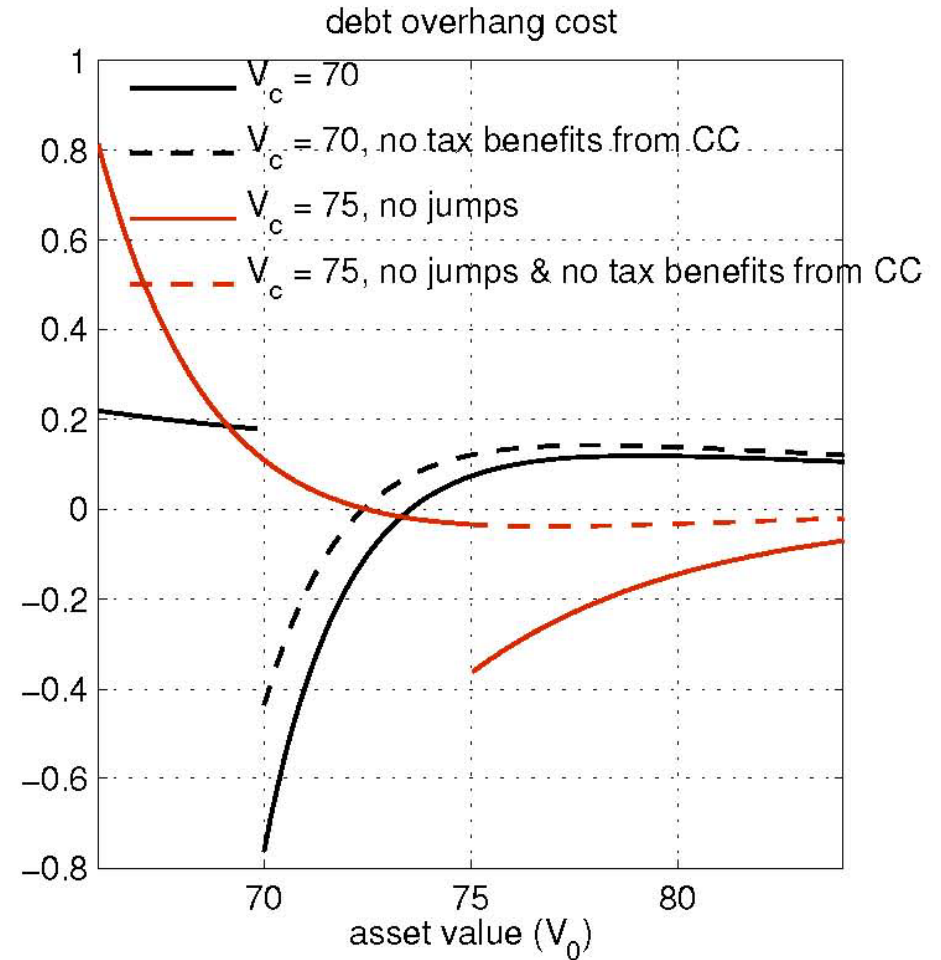
Debt Overhang Cost

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

debt overhang cost

$V_c = 70$

$V_c = 70$, no tax benefits from CC

$V_c = 75$, no jumps

$V_c = 75$, no jumps & no tax benefits from CC

asset value (V_0)

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 Black-Scholes-Merton-style model of equity as a call option on assets – option value increases with volatility
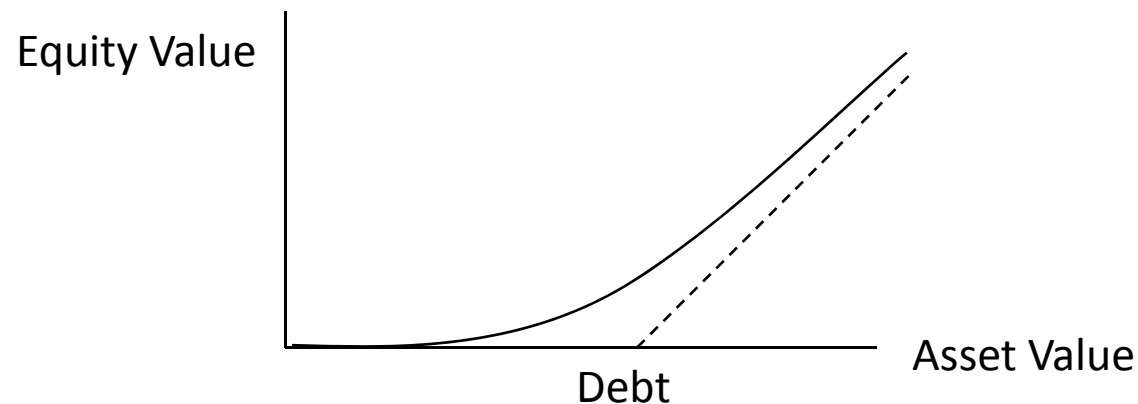
- With debt roll-over, a reduction in default risk benefits shareholders by reducing roll-over costs. What about CoCos?

- Need to consider jumps vs. diffusion and the effect of debt maturity

Asset Substitution

- As in a Black-Scholes-Merton model, equity holders capture the upside
  - This encourages more risk
- Riskier assets increase debt rollover costs
  - Debt is issued at market value but repaid at face value, so risk reduces dividends
  - 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

Summary and Concluding Remarks

- The interactions between endogenous default, debt rollover, and jumps in asset value have significant impact on the functioning of CoCos
- Main observations
  - Trigger needs to be high enough to avoid debt-induced collapse
  - 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
  - Calibration to bank data suggests that CoCos would have had positive effects through the crisis

Thank You