Contingent Capital, Tail Risk, and Debt-Induced Collapse

Nan Chen  Paul Glasserman  Behzad Nouri  Markus Pelger
Chinese University  Columbia University  Columbia University  UC Berkeley
of Hong Kong

Derivatives 2013: The State of the Art
40 Years after the Black-Scholes-Merton Model
NYU Stern
October 11, 2013
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 Tchistyj (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
  - 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
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- 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.)
In the Beginning...

- Black-Scholes (1973), Merton (1974): equity as a call, debt as a put on firm assets
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**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
Default Boundary in Leland (1994)

- Optimal boundary
- Lower boundary: Not feasible
- Higher boundary: Feasible but not optimal
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

$$V_b^* = V_b^{PC} \leq V_c \quad \text{or} \quad V_b^* = V_b^{NC} \geq V_c.$$  

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

![Graph showing the relationship between asset value and equity value in the context of debt-induced collapse. The graph illustrates how changes in asset value affect equity value and default risk.](image)
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.

![Graph showing equity value vs. asset value](graph.png)

- 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
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