

Discussion of “Macroeconomic Conditions and the Puzzles of Credit
Spreads and Capital Structure”
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- Summary of the paper
- The Credit Spread puzzle
- The Capital Structure Puzzle
- Are Both Puzzles Linked?
- Comments

Summary

- ▶ This paper proposes a model for valuing debt and equity that can account for both
 - ▶ Credit Spread puzzle
 - ▶ Capital Structure puzzle
- ▶ Model combines several insights from existing literature
 - ▶ A long-run risk model of the aggregate market return to generate time-varying risk-premia and match the market equity premium (Bansal-Yaron 2004).
 - ▶ A structural model of credit risk with countercyclical default losses to generate large IG credit spreads (Chen, Collin-Dufresne, Goldstein 2005).
 - ▶ A dynamic capital structure model where firms optimally trade trade-off bankruptcy costs and tax benefits and default endogenously (Goldstein, Ju, Leland 2001).
 - ▶ A regime shifting model to link capital structure to Macroeconomy (Hackbarth, Miao, Morellec 2006).
- ▶ Gets closed-form expressions for all quantities (debt, equity, . . .).
- ▶ This (complex) model is calibrated to match:
 - ▶ Observed low default frequency of Baa
 - ▶ Countercyclical variation in default rates
 - ▶ Countercyclical variation in recovery rates
- ▶ It is able to match both the observed level of leverage and credit spreads.

The Asset-Pricing Setup

- ▶ Uses a long-run risk economy where aggregate consumption is continuous but its growth rate and volatility can jump when (Markov chain) state s_t jumps:

$$\frac{dY_t}{Y_t} = \theta_m(s_t)dt + \sigma_m(s_t)dW_t^m$$

- ▶ Stochastic discount factor exhibits time-varying diffusion and jump-risk premia:

$$\frac{d\Lambda_t}{\Lambda_t} = -r(s_t)dt - \gamma\sigma_m(s_t)dW_t^m + J_t d\mathbf{1}_{\{s_t \neq s_{t-}\}}$$

- ▶ Individual firm's EBIT are similar to market cash-flow plus idiosyncratic risk

$$\frac{dX^i}{X^i} = (a^i(\theta_m(s) - \bar{\theta}_m) + \theta_m^i)dt + (b^i(\sigma_m(s) - \bar{\sigma}_m) + \sigma_m^i)dW_t^m + \sigma_{\tau}^i dW_t^i$$

- ▶ Asset value can be estimated by discounting risky cash-flows $V_t^i = E[\int_t^\infty \frac{\Lambda_u}{\Lambda_t} X_u^i du]$
- ▶ Assume time-varying bankruptcy (i.e., dead-weight) costs:

$$\alpha(s) = a_0 + a_1\theta_m(s) + a_2\theta_m^2(s) + a_3\sigma_m(s)$$

The Capital Structure Model

- ▶ Given asset value process, optimal capital structure decision trades off tax benefits of debt for bankruptcy costs:
 - ▶ Firms choose to issue consol bonds with fixed coupons.
 - ▶ Taxable income is EBIT net of coupon (positive and negative income taxed differently).
 - ▶ Equity holders choose an optimal default strategy to maximize the value of their equity.
 - ▶ The optimal leverage (coupon choice) set to maximize the total value of the firm.
 - ▶ Optimal default policy is characterized by a set (as many as market states) of EBIT default boundaries (and upward reorganization boundaries in the dynamic case).
- ▶ Calibration:
 - ▶ The state follows 9 state Markov chain calibrated to aggregate consumption data.
 - ▶ Preference parameters are calibrated to fit equity return moments (risk-free rate, risk-premium and volatility).
 - ▶ cash-flow parameters calibrated to corporate profits for nonfinancial firms.
 - ▶ Idiosyncratic profit volatility calibrated to match 10-year default probabilities.
 - ▶ Bankruptcy cost function calibrated to match recovery rate mean, volatility, and correlation with default rates, consumption and price earnings ratio.
- ▶ Results:
 - ▶ Without business cycle variation 10-year spreads equal 56bps and leverage is 67%.
 - ▶ With business cycle variation Baa 10-yr spreads 140bps, Aaa spreads around 42bps and leverage around 50% (static), 40% (dynamic).
 - ▶ Time varying **countercyclical** bankruptcy costs are crucial for results to obtain.

Expected losses on IG firms are low

- ▶ Investment-grade (IG) firms rarely default.

Moody's 2005 Report: Exhibit 18 - Cumulative Default Rates 1970-2004.

Years	1	2	3	4	5	6	7	8	9	10
Aaa	0.00	0.00	0.00	0.04	0.12	0.21	0.30	0.41	0.52	0.63
Baa	0.19	0.54	0.98	1.55	2.08	2.59	3.12	3.65	4.25	4.89

- ▶ Further, recovery rates are substantial:

Exhibit 27 - Average Recovery Rates by Seniority Class, 1982-2004

Year	Sr. Secured	Sr. Unsec.	Sr. Subord.	Subord. Jr.	Subord.	All bonds
Mean	0.574	0.449	0.391	0.320	0.289	0.422

⇒ expected losses are low...

$$\begin{aligned} \text{Expected loss on 4Y-Baa per year} &= (0.0155)(1 - 0.449)/4 \\ &\approx 21bp \end{aligned}$$

Historical IG Credit Spreads are high

years	4	10
Baa - Treasury	158	194
Aaa - Treasury	55	63
Baa - Aaa	103	131

- ▶ Thus, only 21bp of the 158 (or 103+) are due to expected losses.

Q? Are these credit spreads 'fair compensation' for risk?

A1 No, standard structural models only fit a fraction of observed spreads once calibrated to match historical default rates (Huang and Huang (2003))

Baa-Treas. \approx 32bp vs. actual 158 bp
 Aaa-Treas. \approx 1bp vs. actual 55 bp.

⇒ Several papers argue spreads due to liquidity, tax benefits etc...
 (Elton, Gruber, Agrawal, Mann (2001), Schaefer and Strebulaev (2005)...)

A2 Defaults occur in bad states of nature. If agents are sufficiently risk-averse in these states, then at least the (Baa-Aaa) spread can be explained.

Chen, Collin-Dufresne and Goldstein (2005), Bhamra, Kuehn, Strebulaev (2007), Chen (2007)

Can Structural Models Explain Credit Spread Puzzle?

- ▶ Fundamental pricing formula for discount bond: ($\Lambda \equiv$ stochastic discount factor)

$$\begin{aligned} P &= E \left[\Lambda (1 - \mathbf{1}_{\{\tau \leq T\}} L_\tau) \right] \\ &= E[\Lambda] E \left[1 - \mathbf{1}_{\{\tau \leq T\}} L_\tau \right] + \text{Cov} \left[\Lambda, (1 - \mathbf{1}_{\{\tau \leq T\}} L_\tau) \right] \\ &= \frac{1}{R^f} \left(1 - E \left[\mathbf{1}_{\{\tau \leq T\}} L_\tau \right] \right) - \text{Cov} \left[\Lambda, \mathbf{1}_{\{\tau \leq T\}} L_\tau \right]. \end{aligned}$$

Q? Which models can raise credit spreads while matching historical expected recovery and default rates (i.e., holding 1st term on RHS constant)?

- ▶ Structural models define default as first passage of asset value, V_t , at some default boundary, B_t (\sim liabilities):

$$\tau := \inf\{t : V_t \leq B_t\}$$

\Rightarrow Three possible channels to explain 'credit spread puzzle':

- (1) negative covariance between the pricing kernel (Λ_t) and asset prices (V_t),
- (2) positive covariance between the pricing kernel (Λ_t) and the default boundary (B_t),
- (3) positive covariance between the pricing kernel (Λ_t) and loss rates (L_τ).

Can Structural Models Explain Credit Spread Puzzle?

- ▶ CCDG (2005) show that one can match level and time variation in Baa-Aaa credit spreads within a model that:
 - ▶ has countercyclical sharpe ratios (calibrated to equity premium), and
 - ▶ matches the countercyclical nature of default rates.
 - ▶ Intuition: $P = E[\Lambda \cdot X]$. In recessions state prices (Λ) are high. Recessions are also when most defaults occur. Therefore corporate bond cash-flows X are low (high) precisely in the expensive (cheap) states!
- ▶ However, does not come close to match the (Aaa - Treasury) spread ($\approx 1bps$).
- ▶ Countercyclical default rates obtained via **exogenous** countercyclical default boundary and/or idiosyncratic risk.
- ▶ **Instead** this paper shows that if firms choose their capital structure optimally in a world where risk-premia are time-varying then:
 - ▶ the **endogenous** default boundary delivers the right cyclicity in default rates to match observed credit spreads.
 - ▶ the model also matches observed capital structure levels.
 - ▶ the model explains the entire Aaa-Treasury spread ($\approx 45bps$).
- ▶ Crucial to this model's explanation of both puzzles is the countercyclical bankruptcy cost function.

Leverage is too low

- ▶ In a world without frictions (no taxes, no bankruptcy costs) capital structure is irrelevant (Miller-Modigliani).
- ▶ In a world with taxes but no bankruptcy costs, the optimal capital structure is 100% debt financing.
- ▶ Classic estimates put bankruptcy costs around 10%-23% of firm value (Andrade Kaplan 1998).
- ⇒ Estimates of benefits to increasing leverage typically far exceed estimates of increase in expected bankruptcy costs that would result from higher leverage (Graham 2000).
- ▶ With these numbers typical static trade-off theory calibration deliver optimal leverage ratio greater than 65%.
- ▶ Observed levels are around 30%.
- ▶ However, trade-off theory of capital structure is controversial:
 - ▶ Bankruptcy costs?
 - ▶ Pecking order
 - ▶ Behavioral/managerial (market timing)
 - ▶ ...

The role of countercyclical bankruptcy costs

- ▶ Without business cycle risk, the model generates:
 - ▶ too high leverage (67%)
 - ▶ constant default boundary,
 - ▶ too low spreads (56.6bps) with 10-year default rate calibrated to historical 4.9%.
- ▶ Introducing business cycle risk without time-varying bankruptcy costs does not help:
 - ▶ Optimal leverage is still too high (65.6%), and spreads equal 281bps (but default probability jump to 13.4%).

Q Why?

- ▶ Business cycle risk lowers the PV of tax benefits, since tax benefits are higher in good times than in bad times.
 - ▶ However, it also lowers the PV of bankruptcy costs (because asset value at default is lower in bad times than in good times).
 - ▶ Making the bankruptcy costs strongly countercyclical counteracts this effect and is therefore crucial to solve the capital structure puzzle. By raising the bankruptcy cost in bad states, it increases the PV of bankruptcy costs leading to lower optimal leverage.
 - ▶ However, not clear whether countercyclical bankruptcy costs are needed to solve the credit spread puzzle. For given leverage business-cycle risk will trigger more defaults in recession than in good times (because distance to default is lower in recession).
- Would be good to recalibrate constant bankruptcy cost model to fit historical default probability.

Important point about the spread puzzle: Idiosyncratic risk matters

- ▶ Consider simple Merton (1974) model

$$\frac{dV}{V} + \delta dt = (r + \theta\sigma) dt + \sigma dz$$

where θ is the asset value Sharpe ratio.

- ▶ Default occurs at T if $V(T)$ falls below B . in that case recover $1 - L$.
- ▶ Spread $(y - r)$ on a date- T zero coupon bond is:

$$(y - r) = - \left(\frac{1}{T} \right) \log \left\{ 1 - L N \left[N^{-1} \left(\pi^P \right) + \theta \sqrt{T} \right] \right\}.$$

- ⇒ Even though the model is specified by 7 parameters $\{r, \mu, \sigma, \delta, V(0), B, L\}$, credit spreads only depend on historical default probability, recovery and asset sharpe ratio $\{\pi^P, L, \theta\}$.

Important point about the spread puzzle: Idiosyncratic risk matters

Sharpe	T = 4Y			T = 10Y		
	Baa	Aaa	Baa-Aaa	Baa	Aaa	Baa-Aaa
0.15	44.0	1.6	42.4	67.7	12.0	55.7
0.20	54.9	2.2	52.7	88.1	17.4	70.7
0.25	68.1	3.0	65.1	112.8	24.6	88.2
0.30	83.7	4.1	79.6	141.7	34.2	107.5
0.35	102.0	5.5	96.5	175.1	46.6	128.5
0.40	123.4	7.4	116.0	212.9	62.2	150.7

Table: (Baa - Aaa) spreads as a function of Sharpe ratio. 4Y Baa default rate = 1.55%. 4Y Aaa default rate = 0.04%. 10Y Baa default rate = 4.89%. 10Y Aaa default rate = 0.63%. Recovery rate = 0.449.

- ▶ Typical Baa firm asset value Sharpe ratio estimated around 0.22.
 - ▶ HH only calibrate their models to match historical estimates of $\{\pi^P, L\}$!
- ⇒ The credit spread puzzle only difficult to explain if models are calibrated to *historical expected loss rates and Sharpe ratios*.

Comments

- ▶ Idiosyncratic Risk
 - ▶ What if fit idiosyncratic risk to historically observed values, can the model generate the large spreads and low leverage?
- ▶ Aaa-Treasury spreads: default risk?
 - ▶ This paper generates a spread on 10-year Aaa-Treasury spread of 43bps (81bps for the Aaa consol bond)!
 - ▶ Most of (Aaa - Treasury) may not be due to credit risk, and hence should not be explained by structural models (CDS premia \neq Aaa - Treasury) Grinblatt (1995), Hull, Predescu and White (2005), Elton, Gruber, Aggrawal, Mann (2001), Blanco, Brennan, Marsh (2005), Feldhutter and Lando (2007)
- ▶ There are two sources of default in the model: diffusion to the boundary risk and jump to default risk.
 - ▶ What are the jumps (frequency and magnitudes) generated by the model in the market portfolio and interest rates?
 - ▶ In the 'really' bad states, how many firms default at the same time?
- ▶ Calibration:
 - ▶ How can bankruptcy cost function and idiosyncratic risk be calibrated independently to match respectively moments of recovery rates and default probability?