Marking to Market Corporate Debt
by
Lorenzo Bretscher, Peter Feldhutter, Andrew Kane, and Lukas Schmid

Discussion

Pierre Collin-Dufresne
SFI@EPFL and CEPR

Adam-Smith Workshop 2021
Overview

The original Credit Spread puzzle

The Distress anomaly

Value premium vs. Market leverage factor

Conclusion
Summary

- Provide approximations (‘rule of thumbs’) to compute market leverage based on book-value and other firm characteristics.
- **Overturn four asset pricing puzzles** related to corporate debt:
  - No evidence for **Investment-cash-flow sensitivity** after controlling for market based measure of Tobin’s Q
    - ≠ Fazzari, Hubbard, and Petersen (1988) and . . .
  - No evidence for a **credit-spread puzzle** when using proper market-value based leverage
    - ≠ Huang and Huang (2003) and . . .
  - No evidence for a **financial distress puzzle** when using market-to-book debt values as distress indicator:
    - ≠ Campbell, Hilscher, and Szilagyi (2011) and . . .
  - No evidence for **the value premium** in stock returns, after controlling for market leverage.
    - ≠ Fama, French (1992) and . . .
- Improve **bankruptcy prediction** models using market-value based distance to default measures.
- Identify a **leverage premium** in the cross-section of stock returns.
Suggestion: Write 5 separate papers!

▶ Instead of putting 5 separate ideas in one 80+ page paper, consider writing four or five separate (short) papers!

▶ If you are to overturn 4 seminal papers that have each spawned large follow-up literatures, you might consider spending a (short) paper on each that also address some of the relevant literature to explain why everybody else is wrong.

▶ I would suggest 5 separate papers:
  ▶ Rules of thumb/approximation
  ▶ Investment cash-flow sensitivity
  ▶ Credit spread puzzle
  ▶ Financial distress puzzle
  ▶ Value premium and leverage premium

▶ In that spirit, I will focus mainly on the credit spread puzzle (section 5.3!)

→ Currently, reads like an argument between Feldhutter and Schaeffer (FS2018) and Bai, Goldstein, and Yang (BGY2020) that is difficult to follow for someone not familiar with these two papers.
Is calibrating to market leverage sufficient to overturn the credit spread puzzle?

From Huang and Huang (2003) page 14:

First, we need to choose target parameters for each credit rating. For the base case, the target initial leverage ratio (defined as the ratio of the market value of debt to the market value of firm asset), the target expected equity premium, the target cumulative default probability, and the target default recovery rate are all chosen according to Table 1.

From Chen, CD, and Goldstein (2008) (section 1; figure 1 actually plots market versus book leverage):

We consider three different proxies for the leverage ratio. The first proxy is book leverage (BLV), calculated as the ratio of book debt (obtained from COMPUSTAT) to (book debt + market equity). The second proxy is market leverage (MLV), defined as the ratio of market debt to (market debt + market equity). In particular, we use the Lehman Brothers fixed-income data set to estimate the market value of debt by first determining the market value of debt per dollar of face value for each firm year and then scaling this number by the book debt. The third proxy is the inverse distance-to-default (IDD), which is defined as the ratio of (0.5 × long term book debt + short term book debt) to (market debt + market equity). This last measure is similar to that used by Moody’s KMV for estimating expected default frequencies (EDF). All measures cover the 1974–1998 period due to limitations of the Lehman Brothers fixed-income

Why does it not really matter for HH’s original credit spread puzzle?
Expected losses on IG firms are low but Credit Spreads are high


<table>
<thead>
<tr>
<th>Years</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aaa</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.04</td>
<td>0.12</td>
<td>0.21</td>
<td>0.30</td>
<td>0.41</td>
<td>0.52</td>
<td>0.63</td>
</tr>
<tr>
<td>Baa</td>
<td>0.19</td>
<td>0.54</td>
<td>0.98</td>
<td>1.55</td>
<td>2.08</td>
<td>2.59</td>
<td>3.12</td>
<td>3.65</td>
<td>4.25</td>
<td>4.89</td>
</tr>
</tbody>
</table>

► Further, recovery rates are substantial: Exhibit 27 - Average Recovery Rates by Seniority Class, 1982-2004

<table>
<thead>
<tr>
<th>Year</th>
<th>Sr. Secured</th>
<th>Sr. Unsec.</th>
<th>Sr. Subord.</th>
<th>Subord. Jr.</th>
<th>Subord.</th>
<th>All bonds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.574</td>
<td>0.449</td>
<td>0.391</td>
<td>0.320</td>
<td>0.289</td>
<td>0.422</td>
</tr>
</tbody>
</table>

⇒ Expected losses are low, e.g., (0.0155)(1 − 0.449)/4 ≈ 21bp per year for 4Y-Baa.

► But average credit spreads are high!

<table>
<thead>
<tr>
<th>maturity (years)</th>
<th>4</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baa - Treasury</td>
<td>158</td>
<td>194</td>
</tr>
<tr>
<td>Aaa - Treasury</td>
<td>55</td>
<td>63</td>
</tr>
<tr>
<td>Baa - Aaa</td>
<td>103</td>
<td>131</td>
</tr>
</tbody>
</table>

⇒ Thus, only 21bp of the 158bp due to expected losses. (or 21 bp of 103+ if some of AAA-Trsy is due to liquidity).

► Is the rest compensation for credit risk (or taxes, or illiquidity, or....)?
Can structural models explain these high credit spreads?

- Early calibrations show wide dispersion across different structural models (e.g., Eom, Helwege, and Huang (2002))

- But, once models are calibrated to match historical expected losses (21bps) then Huang and Huang (2003) show that structural models consistently predict too low spreads, especially for IG firms:
An example: HH-calibration of the Merton model

- **Asset value process**
  \[ \frac{dV}{V} + \delta \, dt = (r + \theta \sigma) \, dt + \sigma \, dz \]
  where \( \theta = \frac{\mu - r}{\sigma} \) is the asset value Sharpe ratio.

- **Bond default at** \( T \) **if** \( V_T \) **below Default Boundary** \( B \) **and recovers** \( 1 - L \).

- **The Credit Spread** \( (y - r) \) **on a date-**\( T \) **zero coupon bond can be expressed:**
  \[ (y - r) = - \left( \frac{1}{T} \right) \log \left\{ 1 - L \, N \left[ N^{-1} (\pi^P) + \theta \sqrt{T} \right] \right\} . \]

⇒ **Even though model has 7 parameters** \( \{ r, \mu, \sigma, \delta, V_0, B, L \} \), credit spread only depends on **P-measure default probability, recovery, and sharpe ratio** \( \{ \pi^P, L, \theta \} \).

- **If** \( \pi^P, L \) **are calibrated to historical default and recovery data, then spread is pinned down by asset value Sharpe ratio** \( \theta \) **only!**

**Q? Why does the Initial Market Leverage matter for calibration?**

**A!** **Unknown default boundary** specified as fraction of Book-debt \( (B = d \, D^{book}) \) and asset value measured by market equity plus debt \( (V_0 = E_0 + D_0^{mkt}) \).

⇒ In the model \( \pi^P(d, V_0, D^{book,mkt}) = Prob(V_T < B) \).

⇒ But, if \( d \) is calibrated to match historical \( \pi^P \), then **market leverage does not matter!**

⇒ But FS, BGY, and BFKS do not fit \( d \) to historical \( \pi^P \) (viewed as too ‘noisy’).

⇒ **Their solution of the CS puzzle is to use an estimator that results in a larger** \( \pi^P \)!
Remark: HH’s Credit Spread puzzle is sensitive to asset Sharpe Ratio

- Credit spreads in the simple model for different values of the Sharpe Ratio ($\theta$) and given that $(\pi^P, L)$ match historical data.

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

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 $(\pi^P, L)$!

$\Rightarrow$ The credit spread puzzle only difficult to explain if models are calibrated to historical expected loss rates and Sharpe ratios.
Can Structural Models Explain HH’s Credit Spread Puzzle?

- Fundamental pricing formula for discount bond: \( (\Lambda \equiv \text{pricing kernel}) \)

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

**Q?** How to lower bond prices holding expected loss (1st term on RHS) constant?

⇒ Explains why HH find that different structural models predict same spreads when calibrated to match \( \pi^P, L \). They typically specify fairly restrictive pricing kernels.

- Chen, CD, Goldstein (2008) 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),
  - countercyclical default rates obtained via countercyclical default boundary, and
  - matches historical average of \( \pi^P, L, \theta \).

→ Intuition: In recessions state prices \( (\Lambda) \) are high. Recessions are also when most defaults occur. Therefore corporate bond cash-flows are low (high) precisely in the expensive (cheap) states!
Can Structural Models Explain Credit Spread Puzzle?

- The current paper solves the credit spread puzzle by estimating $\pi^P$ using an approach proposed in FS(2018), which results in a much higher value than historical average.
  - FS argue that due to low historical default rates, historical average is noisy estimate of $\pi^P$, especially for IG firms.
  - Instead, propose to estimate jointly PDs for IG and HY firms based on model default probability ($\overline{\pi}^P_a(d)$) and cross-equation restriction that firms' default boundary are all at the same distance of their initial leverage, i.e.,
    $$B^a = d D^a \forall a = AAA, AA, BBB, \ldots C.$$ 
    $$\min_{\{d\}} \sum_{a=AAA}^{C} \sum_{T=1}^{20} \frac{1}{T} \left| \overline{\pi}^P_{aT}(d) - \hat{\pi}^P_{aT} \right|.$$ 
    → estimate one common $d$-parameter for all firms across all ratings.
    → Their actual estimate of $\pi^P$ then depends on each firm's initial specific leverage.

Q? Is that estimator of $\pi^P$ for IG firms better than the historical average?

A! depends on accuracy of assumption about $d$ and of ability of model to fit cross-section of firm default probabilities...
How plausible is this explanation of the credit spread puzzle?

- FS still need to rely on (IG and HY) historical default rates for their calibration approach:
  - Use Moody’s default rates from **1920-2012** which are about twice those for 1970-2003 used by HH,
  - to explain average spreads from **1997-2018**!

- Given significant correlation between spreads and default rates, it might be wise to look at spreads and default rates over same period.

- Surprisingly, average spreads not very different across sub-periods (average for 1920-2012 is 120bps; 1970-2004 is 109bps; 1997-2018 is 100bps).
How plausible is this explanation of the credit spread puzzle?

► Would be quite ironic that a simple Merton Model with constant volatility, no jumps, constant risk-premia would work great for credit spreads, when the equity-premium literature consensus is that we need long-run risk, time-varying risk-premia, stochastic volatility, time-varying disasters.

► Simple Black-Cox model used (without SV, jumps) generates the \textbf{wrong skew slope} for the term structure of \textbf{credit-option volatilities} (CD, Junge, Trolle (2020)).

![Figure 5: In-sample fit to CDX and SPX implied volatility smiles](image)

► Alternative approach to get more robust estimate of $\pi^P$: use \textbf{international data}. Huang, Nozawa, and Shi (2019) “\textbf{The global credit spread puzzle}” find evidence more consistent with HH (and inconsistent with common $d$ for IG and HY firms) using international corporate bond data.
High Credit risk-premium stocks earn high returns.

- Stocks with high credit risk-premium (CRP) estimated from CDS (Friewald, Wagner Zechner (2014)) or from bonds (Anginer and Yildizhan (2018)):
  - earn high returns
  - have high FF-factor exposures

<table>
<thead>
<tr>
<th>CRP Measure</th>
<th>Excess return</th>
<th>CAPM alpha</th>
<th>Three-factor alpha</th>
<th>Four-factor alpha</th>
<th>MKT</th>
<th>SMB</th>
<th>HML</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>0.463***</td>
<td>-0.074</td>
<td>-0.021</td>
<td>0.01</td>
<td>0.890***</td>
<td>-0.319***</td>
<td>0.020</td>
</tr>
<tr>
<td></td>
<td>(1.65)</td>
<td>(0.52)</td>
<td>(0.17)</td>
<td>(0.08)</td>
<td>(27.51)</td>
<td>(9.29)</td>
<td>(0.47)</td>
</tr>
<tr>
<td>2</td>
<td>0.489**</td>
<td>0.048</td>
<td>0.026</td>
<td>-0.000</td>
<td>0.971***</td>
<td>-0.287***</td>
<td>0.017</td>
</tr>
<tr>
<td></td>
<td>(2.19)</td>
<td>(0.45)</td>
<td>(0.24)</td>
<td>(-0.20)</td>
<td>(41.48)</td>
<td>(-8.35)</td>
<td>(0.48)</td>
</tr>
<tr>
<td>3</td>
<td>0.552**</td>
<td>-0.033</td>
<td>0.006</td>
<td>0.001</td>
<td>0.909***</td>
<td>-0.131***</td>
<td>0.050</td>
</tr>
<tr>
<td></td>
<td>(2.31)</td>
<td>(-0.25)</td>
<td>(0.05)</td>
<td>(0.99)</td>
<td>(37.17)</td>
<td>(-3.66)</td>
<td>(1.35)</td>
</tr>
<tr>
<td>4</td>
<td>0.568**</td>
<td>-0.053</td>
<td>-0.116</td>
<td>0.000</td>
<td>0.978***</td>
<td>-0.105***</td>
<td>0.046</td>
</tr>
<tr>
<td></td>
<td>(2.29)</td>
<td>(-0.39)</td>
<td>(-0.86)</td>
<td>(0.28)</td>
<td>(36.24)</td>
<td>(-2.66)</td>
<td>(1.12)</td>
</tr>
<tr>
<td>5</td>
<td>0.574**</td>
<td>0.095</td>
<td>0.020</td>
<td>-0.001</td>
<td>1.022***</td>
<td>-0.066**</td>
<td>0.190***</td>
</tr>
<tr>
<td></td>
<td>(2.29)</td>
<td>(0.68)</td>
<td>(0.14)</td>
<td>(-0.75)</td>
<td>(39.59)</td>
<td>(-1.73)</td>
<td>(4.84)</td>
</tr>
<tr>
<td>6</td>
<td>0.608***</td>
<td>0.069</td>
<td>0.092</td>
<td>0.002</td>
<td>1.032***</td>
<td>0.004</td>
<td>0.281***</td>
</tr>
<tr>
<td></td>
<td>(2.66)</td>
<td>(0.47)</td>
<td>(0.62)</td>
<td>(1.56)</td>
<td>(35.49)</td>
<td>(0.09)</td>
<td>(6.36)</td>
</tr>
<tr>
<td>7</td>
<td>0.619*</td>
<td>0.063</td>
<td>0.004</td>
<td>-0.000</td>
<td>1.114***</td>
<td>0.157***</td>
<td>0.419***</td>
</tr>
<tr>
<td></td>
<td>(1.73)</td>
<td>(0.54)</td>
<td>(0.04)</td>
<td>(-0.21)</td>
<td>(35.73)</td>
<td>(3.43)</td>
<td>(8.86)</td>
</tr>
<tr>
<td>8</td>
<td>0.621**</td>
<td>-0.012</td>
<td>-0.053</td>
<td>0.002</td>
<td>1.217***</td>
<td>0.192***</td>
<td>0.324***</td>
</tr>
<tr>
<td></td>
<td>(2.21)</td>
<td>(-0.10)</td>
<td>(-0.46)</td>
<td>(1.12)</td>
<td>(31.57)</td>
<td>(5.15)</td>
<td>(5.54)</td>
</tr>
<tr>
<td>9</td>
<td>0.795**</td>
<td>0.054</td>
<td>0.015</td>
<td>-0.000</td>
<td>1.239***</td>
<td>0.231***</td>
<td>0.575***</td>
</tr>
<tr>
<td></td>
<td>(2.45)</td>
<td>(0.49)</td>
<td>(0.14)</td>
<td>(-0.15)</td>
<td>(29.70)</td>
<td>(5.00)</td>
<td>(8.39)</td>
</tr>
<tr>
<td>High</td>
<td>0.984***</td>
<td>0.325</td>
<td>-0.193</td>
<td>0.005</td>
<td>1.28***</td>
<td>0.157***</td>
<td>0.715***</td>
</tr>
<tr>
<td></td>
<td>(2.58)</td>
<td>(1.33)</td>
<td>(0.93)</td>
<td>(0.02)</td>
<td>(22.83)</td>
<td>(2.63)</td>
<td>(9.62)</td>
</tr>
<tr>
<td>High-low</td>
<td>0.521**</td>
<td>0.399</td>
<td>-0.172</td>
<td>-0.005</td>
<td>0.391***</td>
<td>0.476***</td>
<td>0.695***</td>
</tr>
<tr>
<td></td>
<td>(1.98)</td>
<td>(1.50)</td>
<td>(0.75)</td>
<td>(0.02)</td>
<td>(6.32)</td>
<td>(7.25)</td>
<td>(8.49)</td>
</tr>
</tbody>
</table>

Source: Anginer and Yildizhan (2018)

→ Compare Market Leverage measure to CRP measures used in these papers?
Controlling for other factors?

- The value premium has been negative since 2008 (half your sample)!

- Would be interesting to control for other factors, such as BAB, momentum, volatility etc... and market beta (which should be related to leverage).

- How different is your $MB^{Debt} = \frac{MV^{Debt}}{BV^{Debt}}$ from just using the firm credit spread (bond or CDS)?

- All the results are presented for equal-weighted portfolios. Would be interesting to present also value-weighted returns (typically more robust).
Conclusion

▶ Fantastic data set. Amazing work in putting all these data sources together.

▶ Controversial findings: overturn 4 well-known empirical findings.
  ▶ Investment cash-flow sensitivity
  ▶ Credit spread puzzle
  ▶ Financial distress puzzle
  ▶ Value premium and leverage premium

▶ Would recommend digging a bit deeper into each, perhaps in separate papers.