Quantifying Liquidity and Default Risks of Corporate bonds over the Business Cycle
by
Chen, Cui, He, and Milbradt

Discussant:  Pierre Collin-Dufresne

NBER July 2013
Overview

The Credit Spread puzzle

Default-based component

Liquidity-based component

Comments

Conclusion

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Overview

- Ambitious paper that merges several strands of literature:
  - Structural model of credit risk with Endogenous Default and Capital Structure (LT96)
  - Microstructure search-based Model of OTC market illiquidity (DGP05)
  - Macro-finance long-run risk model of the pricing kernel (Bansal-Yaron (BY04))

- Builds on previous work by same authors:
  - Chen (2010) models credit component of credit spreads combining
    - Dynamic capital structure model of Leland (1994)
    - Long-Run risk model of the equity premium (BY04)

  - He and Xiong (2010) model the liquidity component of credit spreads combining:
    - Finite Maturity dynamic capital structure model (LT96)
    - Exogenous trading cost model in secondary bond market (Amihud-Mendelsohn (1986))

  - He and Milbradt (2012) endogenize the secondary bond market illiquidity combining:
    - LT96
    - Search-based model of OTC markets (DGP05)

- The goal in combining these different models is to “provide a full resolution of the credit spread puzzle by quantitatively explaining both the default and non-default component of the credit spreads.”
Expected losses on IG firms are low

- Investment-grade (IG) firms rarely default.

<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><strong>0.04</strong></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><strong>1.55</strong></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><strong>0.449</strong></td>
<td>0.391</td>
<td>0.320</td>
<td>0.289</td>
<td>0.422</td>
</tr>
</tbody>
</table>

⇒ expected losses are low...

Expected loss on 4Y-Baa per year = \((0.0155)(1 - 0.449)/4\)
≈ 21bp

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Historical IG Credit Spreads are high

<table>
<thead>
<tr>
<th>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 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 (Jones, Mason and Rosenfeld (1984), 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 Streibulaev (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, Goldstein (2009), Bhamra, Kuehn, Streibulaev (2010), Chen (2010)
Can Structural Models Explain Credit Spread Puzzle?

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

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

Q? Which models can raise credit spreads while matching historical expected recovery and default rates (i.e., holding 1\(^{st}\) 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 \((\Lambda_t)\) and asset prices \((V_t)\),
2. positive covariance between the pricing kernel \((\Lambda_t)\) and the default boundary \((B_t)\),
3. positive covariance between the pricing kernel \((\Lambda_t)\) and loss rates \((L_\tau)\).
Can Structural Models Explain the Credit Spread Puzzle?

- CCDG (2009) 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 via **exogenous** countercyclical default boundary

- However, does not come close to match the (Aaa - Treasury) spread ($\approx 1bp$s).

- Chen (2010) shows that if firms choose their capital structure to optimize the trade-off between taxes and bankruptcy costs in a world where risk-premia are time-varying then:
  - The **endogenous** default boundary delivers the right cyclicality in default rates to match observed credit spreads as well as leverage levels for Baa firms.
  - But the model is unable to match both spread and leverage of Aaa firms.
    - Given their low empirical default rates the trade-off model tends to predict higher Aaa leverage than observed.
    - and explains entire Aaa-Treasury (and therefore Baa-Treasury) spread.
  - N.B: Crucial to his model’s explanation of the credit and leverage puzzles are countercyclical bankruptcy costs. This raises their PV and thus lowers optimal leverage.

⇒ Can introducing secondary bond market illiquidity explain the ‘non-default’ ($\sim$ Aaa-Treasury) component of credit spreads and the low observed Aaa leverage ratios?

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Liquidity-based component

  - Firms commit to continuously roll-over a portion of the maturing debt to maintain constant average maturity.
  - Bond investors can be hit with a liquidity shock whereupon they must sell their bond and pay an exogenous trading cost.
  - They take this cost into account when they buy bonds in the primary market, where firms issue at a lower price than the "fair" arbitrage-free price.
  - Comparative statics lead to a liquidity-credit feedback: an increase in the cost of trading bonds increases the roll-over cost and leads to a higher default boundary thus raising credit spreads.

  - Firms sell bonds in the primary market to High type investors.
  - With some intensity H-types can become L-types who pay a continuous cost for holding the bond.
  - L-types seek to sell their bond to H-types, which they can do via intermediaries (search).
  - Importantly, assume that in bankruptcy recovery is not paid out instantly. This implies that L-types have lower recovery values than H-types.
  - Model generates endogenous bid-ask spread for bonds that is increasing in credit risk.
  - Comparative static leads to a credit-liquidity spiral: a bad shock to firm value increases the default probability, which increases the valuation differential between H and L types, which increases the transaction costs, which lowers the bond value, which increases the roll-over cost, which increases the default probability...
This paper combines He-Milbradt (2012) with Chen (2010) = LT96+DGP05+BY04.

It allows for time variation (state dependence) in:
- the H to L switching intensity: higher in bad times.
- the intermediary search intensity: lower in bad times.
- the holding costs of L-types: higher in bad times.

This generates time-variation over time in liquidity and risk component of credit spreads.

Comparative static experiments of He-Xiong and He-Milbradt occur now ‘within’ the model.

Since the (endogenous) transaction costs are higher in bad times when marginal utilities are higher, this increases the liquidity component of credit spreads.

It helps with the credit spread puzzle in making the default boundary more countercyclical (due to liquidity-credit feedback).

It helps with the leverage puzzle, since firms are now trading off tax benefits against both bankruptcy and liquidity costs, which are both countercyclical.

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On the Liquidity-based explanation theory

- There are search frictions in OTC secondary market (difficult for L-type to find H-type), but there are none in the primary bond issuance markets? Firms continuously issue bonds to a H-type buyer (no-search cost).

- Instead, evidence on new-issue discounts (Newman and Rierson) suggests that trading costs may be high in primary markets as well.

- If firms worry about obtaining credit in the primary market then issuance decision of firms is very different (Hugonnier, Malamud, Morellec (2012) introduce search frictions in primary market).

- Even in present setup, is it optimal to commit to continuously roll-over debt?

- There are no trading frictions in the equity market?

- If investors can freely trade asset value (or equity) and the money market, then they face a complete market. They can also replicate the promised payments of the bond. The replicating portfolio has different value than the secondary market price of the bond.

→ How do we think about the exogenous pricing kernel? (Does it price the bond?)
The exogenous pricing kernel

- The pricing kernel (i.e., both risk-premia and risk-free rate) is independent of the ‘illiquidity’ in the secondary bond market.

- In fact the authors state that: “motivated by the US economy we have assumed a constant risk-free rate”! (is it needed for tractability?)

- This makes it difficult to address questions about the impact of “Liquidity provisions of the FED”

- Presumably the FED considers intervening in secondary (corporate) bond markets a monetary policy tool because it hopes to have an impact on real activity (perhaps via long term rates and risk-premia).

⇒ Needs another feedback (‘spiral’) from secondary market liquidity to risk-premia and real activity.

- The role of financial intermediaries is very limited in this model. They have no risk since they always perfectly match High and Low type investors and take a cut. In fact, they make more money (with no risk) in bad states.

- Presumably the FED’s action were motivated by financial intermediaries balance sheets and their ability to extend more credit, which is not easy to investigate in this framework.
The swap-Treasury spread

- Risk-based explanations can explain the Baa-Aa spread (≈ Baa-Swap spread).

- The paper shows that adding a model of secondary bond market illiquidity can explain the full Baa-Treasury spread.

- Thus the Swap-Treasury spread must be due to secondary bond market illiquidity (due to search frictions?).

- But the swap market is extraordinarily liquid and hardly requires any search costs.

- A casual look at changes in the LIBOR-Treasury spread during the crisis suggests that a lot of the action is driven by large drops in Treasury yields.

- Treasury rates do not represent the ‘risk-free’ rate individuals should use to discount risk-free cash-flows. They cannot fund themselves at that rate.

- The difference might be due to Treasury specialness:
  - Flight to quality
  - Flight to liquidity/money
  - Collateral value

⇒ Treasury ≠ r in the model.
Conclusion

- This paper proposes an ambitious model that combines the paper of Chen (2010) with that of He-Milbradt (2012) to endogenize the firm's default boundary and leverage as well as secondary market bond transaction costs over the business cycle.

- The careful calibration shows the model is very promising.

- Several assumptions make it perhaps not the best framework to analyze liquidity provisions of the FED or the LIBOR-Treasury spread.
  - Exogenous pricing kernel
  - Absence of role for financial intermediaries balance sheets.
  - No special (flight to quality or collateral) role of Treasuries.

- Instead, the paper's focus on microstructure search-based illiquidity in the secondary bond market makes it very well-suited to investigate the cross-section of the CDS-bond basis (relative to LIBOR or Treasury).

- Secondary market illiquidity is bond specific and depends on bond characteristics. This model makes many interesting predictions.

- In fact, during the 2007-2010 period the CDS-Bond basis is very strongly linked cross-sectionally to bond specific measures of trading costs such as bid-ask spread and leverage (Bai-CDG (2012)).