Quantifying Liquidity and Default Risks of Corporate bonds over the Business Cycle
by
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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.
  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

$\Rightarrow$ 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 (Jones, Mason and Rosenfeld (1984), Huang and Huang (2003))

$$\begin{array}{lccc} \text{Baa-Treas.} \approx 32\text{bp} & \text{vs.} & \text{actual } 158 \text{ bp} \\ \text{Aaa-Treas.} \approx 1\text{bp} & \text{vs.} & \text{actual } 55 \text{ bp.} \end{array}$$

⇒ 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, Goldstein (2009), Bhamra, Kuehn, Strebulaev (2010), Chen (2010)

Can Structural Models Explain Credit Spread Puzzle?

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

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

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):

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

$\Rightarrow$ 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 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** countercylical default boundary
- However, does not come close to match the (Aaa - Treasury) spread ($\approx 1bps$).
- 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 PVand 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?

Liquidity-based component

- He-Xiong (2010) =LT96+ Amihud-Mendelson (1986)
  - 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.
- He-Milbradt (2012)= LT96 + DGP05.
  - 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

- 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 are now trading off tax benefits against both bankruptcy and liquidity costs, which are both countercyclical.

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).

$\Rightarrow$ 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 ($\sim$ 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 yieds.
- 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

$\Rightarrow$ Treasury $\neq r$ in the model.

Conclusion

- This papers proposes an ambitious model that combines the paper of Chen (2010) with that of He-Milbradt (2012) to endogenize the firms 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.
  - Exgenous 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)).