Dynamic Dispersed Information and the Credit Spread Puzzle
by Albagli, Hellwig and Tsyvinski

Discussion by: Todd B. Walker

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Crude Approximation

- Exogenous value of firm $\theta_{t+1} \sim N(\rho \theta_t, \sigma^2_{\theta})$

- Risk Neutral Traders get noisy signal on tomorrow’s firm value $x_t \sim N(\theta_{t+1}, \beta^{-1})$

- Bond holdings restricted to unit interval

- Noise traders take $\Phi(u_t)$ of bonds Market clearing:

  $1 - \Phi(\sqrt{\beta}(\hat{x}(\theta, P) - \theta_{t+1})) + \Phi(u) = 1$
Key Idea

Variance of Fundamentals vs. Market Implied Variance of Fundamentals

\[ \Phi\left(\frac{\theta' - \rho \theta}{\sigma_\theta}\right) \]

\[ \Phi\left(\frac{\theta' - \rho \theta}{\sigma_P}\right) \]

\[ \sigma_P^2 = \sigma_\theta^2 + (1 + \sigma_u^2)\left[\frac{\beta}{(1/\sigma_\theta^2 + \beta + \beta/\sigma_u^2)}\right]^2 \]
Crude Approximation

\[ \theta_+ \sim N(\bar{\theta}, \sigma^2_{\theta}) \]
Crude Approximation

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Crude Approximation

\[ \theta_+ | x \sim N(\bar{\theta}, \sigma_P^2) \]

Market Implied Default Probability
Crude Approximation

\[
\frac{\text{Market Implied Default Probability}}{\text{Actual Default Probability}} = \frac{16.354\%}{2.5\%}
\]
Crude Approximation

\[
\frac{\text{Market Implied Default Probability}}{\text{Actual Default Probability}} = \frac{30.854\%}{15.866\%}
\]
Compliment/Criticism Sandwich

1. Start with praise
   - You are a genius

2. Add some minor changes
   - Please fix the typos

3. Layer on more praise
   - Brilliant

4. Add the meat of the criticism
   - Criticism

5. Another helping of praise
   - You have a gift

6. Cover a few minor edits
   - Minor edits

7. Finish with praise
   - This is your OPUS

8. Bon appétit
   - I don't eat meat

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by Tom Fishburne

BRAND CAMP

CRITICISM SANDWICH
NREE Models are typically static, linear, not quantitative.

“Thus, despite the importance of the framework and more than 30 years since Grossman and Stiglitz, NREE models are still far from being a mainstream tool for asset-pricing.”
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“Thus, despite the importance of the framework and more than 30 years since Grossman and Stiglitz, NREE models are still far from being a mainstream tool for asset-pricing.”

“A key contribution of our paper is that this (NREE) equilibrium representation can be taken to the data in a direct, quantitative way.” [Kasa, Walker and Whiteman (REStud, 2014)]

Yes! Brilliant Bread
Criticism Meat

- Empirical motivation (Introduction, most of Section 2)
  1. Section 2.1 Stylized facts
  2. Section 2.2 Credit spreads from a no-arbitrage perspective

- Theory
  1. Fixing structural model
  2. “Dynamic”? model
Section 2.1: Stylized Fact II

Table 1: Historical Default rates, Yield Spreads, and Spread Ratios

<table>
<thead>
<tr>
<th></th>
<th>Average Yield Spread (bps)</th>
<th>Cumulative Default Rates (%)</th>
<th>Spread Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 yr</td>
<td>10 yr</td>
<td>4 yr</td>
</tr>
<tr>
<td>Aaa</td>
<td>55</td>
<td>63</td>
<td>1.1</td>
</tr>
<tr>
<td>Aa</td>
<td>65</td>
<td>91</td>
<td>6.0</td>
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<tr>
<td>A</td>
<td>96</td>
<td>123</td>
<td>9.9</td>
</tr>
<tr>
<td>Baa</td>
<td>158</td>
<td>194</td>
<td>32.0</td>
</tr>
<tr>
<td>Ba</td>
<td>320</td>
<td>320</td>
<td>172.3</td>
</tr>
<tr>
<td>B</td>
<td>470</td>
<td>470</td>
<td>445.7</td>
</tr>
</tbody>
</table>

Table 2: Observed vs. calculated credit spreads

<table>
<thead>
<tr>
<th></th>
<th>Average Yield Spread* (bps)</th>
<th>Calculated Yield Spreads</th>
<th>Fraction explained (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 yr</td>
<td>10 yr</td>
<td>4 yr</td>
</tr>
<tr>
<td>Aaa</td>
<td>55</td>
<td>63</td>
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</tbody>
</table>

1 Average yield spreads and calculated yield spreads are taken from Table 1 of Huang and Huang (2012).
Structural Model: Criticisms

This is old news...
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- Huang & Huang (2012): Use empirical default rates to back out credit spreads

- Gaussian Distribution Performs Poorly in the Tails: Zhang et al. (BIS, 2005).


- Ridiculous Predictions: Eom et al (RoFS, 2004) found that the structural model often predicted default probabilities that were “ridiculously small or incredibly large.”
AHT Conclude

- AHT use H-J Bound to show structural model calibrated to empirical default probabilities cannot come close to explaining credit spread.

- No more! Mercy!
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- AHT conclude: “Any attempt to account for observed credit spreads in the context of a no-arbitrage model thus rests on the premise that observed bond yields account aggregate default risk not observed in the data, and the utility costs of such default risk must be exceedingly large.”
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A bit strong...
Several structural models using recent data from crisis and new macro factors (e.g., liquidity) are much improved.

“IT is commonly accepted that the non-default component of credit spreads is a liquidity premium to compensate investors for the liquidity risk when holding corporate bonds.”
Illiquidity

Credit spreads (double lines, left scale) and Roll's illiquidity measure (single line, right scale) for Aaa/Aa (dashed) and Baa (solid) rated bonds. Credit spread data is from St. Louis Fed at http://research.stlouisfed.org/fred2, and Roll's illiquidity measure follows from Bao et al. [2011] using TRACE data (available after 2004). Grey areas are NBER recessions.

The general empirical pattern of liquidity for corporate bonds, both in the cross-section and in the time-series, is shown in Figure 1, where we plot the credit spreads (left scale) and the "Roll's measure" of bond illiquidity (following Bao et al. [2011], right scale) over 1997-2011 for both Aaa/Aa and Baa rating classes that are studied extensively in the literature. Consistent with Dick-Nielsen et al. [2011] and Friewald et al. [2012], both credit spread and bond illiquidity exhibit strong counter-cyclical patterns, suggesting that recessions come with a soaring price of risk and worsening secondary market liquidity. Further, riskier bonds are coupled worse liquidity in the secondary market, and more so when the economy encounters a recession. This latter cross-sectional pattern implies the importance of endogenous liquidity in modeling the non-default component of corporate bonds.
Empirical motivation needs to reflect more recent literature

Focus on asymmetries (Stylized Fact II) and forecast disagreement of Patton and Timmerman (2010) (Stylized Fact III)

Update data through crisis (2001 only?)

Use H-J Bound to show that liquidity is not enough...need NREE to explain remainder of credit spread
Theoretical Brilliant Bread

Are AHT fixing structural model?
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\[
V_t = S_t + D_t
\]

Firm Value = Equity + Debt

Zero-Coupon Debt \((D_t)\): face value \(F\), maturity date \(J\).
Theoretical Brilliant Bread

Are AHT fixing structural model?

\[ V_t = S_t + D_t \]

Firm Value = Equity + Debt

Zero-Coupon Debt \((D_t)\): face value \(F\), maturity date \(J\).

Bond holders: time-\(J\) value of \(\min[V_J, F]\)

Equity holders: residual claimants, \(\max[V_J - F, 0]\).

\[
S_t = e^{-r(J-t)} \mathbb{E}_t^Q \{ \max[V_J - F, 0] \} \tag{1}
\]

\[
D_t = e^{-r(J-t)} \mathbb{E}_t^Q \{ \min[V_J, F] \} \tag{2}
\]
Structural Model: Intuition

Equity as a call option on the value of the assets of the firm with a strike price equal to the firm’s liabilities.
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**Figure 1: Distribution of Firm Value**

[Diagram showing the distribution of firm value with a peak indicating the default point (EDP).]
Structural Model: Intuition

Equity as a call option on the value of the assets of the firm with a strike price equal to the firm’s liabilities.

Figure 1: Distribution of Firm Value
Structural Model

- Assuming firm value follows geometric Brownian motion

\[
d \ln V_t = \left( \mu_V - \frac{\sigma_V^2}{2} \right) dt + \sigma_V dW_t
\]

\[
\ln V_{t+j} \sim \mathcal{N}(\ln V_t + [\mu_V - \sigma_V^2/2] J, \sigma_V^2 J)
\]
Assuming firm value follows geometric Brownian motion

\[ d \ln V_t = \left( \mu_V - \frac{\sigma_V^2}{2} \right) dt + \sigma_V dW_t \]

\[ \ln V_{t+j} \sim \mathcal{N}(\ln V_t + [\mu_V - \sigma_V^2 / 2] J, \sigma_V^2 J) \]

Therefore the probability of default is

\[ \pi_t = Pr \left( \ln(V_t) + \left( \mu - \frac{\sigma_V^2}{2} \right) J + \sigma_V \sqrt{J} \varepsilon_{t+J} \leq \ln(F') \right) \]

\[ = Pr \left( -\frac{\ln(V_t) - \ln(F) + (\mu_V - \sigma_V^2 / 2) J}{\sigma_V \sqrt{J}} \geq \varepsilon_{t+J} \right). \]
Dynamic? Investors live for only one period...leaves out higher-order belief dynamics

$$p_t = \beta \int_0^1 \mathbb{E}_t^i p_{t+1} \phi(i) di + d_t$$  \hspace{1cm} (3)
Higher-Order Beliefs

\[ p_t = \beta \left\{ 0.5 \mathbb{E}_t^1 p_{t+1} + 0.5 \mathbb{E}_t^2 p_{t+1} \right\} + d_t \]
\[ = \beta \mathbb{E}_t p_{t+1} + d_t \]

\[ \mathbb{E}_t \mathbb{E}_{t+1} p_{t+2} = 0.5 \mathbb{E}_t \left\{ 0.5 (\mathbb{E}_{t+1}^1 p_{t+2} + \mathbb{E}_{t+1}^2 p_{t+2}) \right\} + 0.5 \mathbb{E}_t^2 \left\{ 0.5 (\mathbb{E}_{t+1}^1 p_{t+2} + \mathbb{E}_{t+1}^2 p_{t+2}) \right\} \]
\[ = 0.25 [\mathbb{E}_{t+1}^1 p_{t+2} + \mathbb{E}_{t+1}^2 p_{t+2}] + 0.25 [\mathbb{E}_t^1 \mathbb{E}_{t+1}^2 p_{t+2} + \mathbb{E}_t^2 \mathbb{E}_{t+1}^1 p_{t+2}] \]
\[ = 0.5 \mathbb{E}_t p_{t+2} + 0.25 [\mathbb{E}_t^1 \mathbb{E}_{t+1}^2 p_{t+2} + \mathbb{E}_t^2 \mathbb{E}_{t+1}^1 p_{t+2}] \]  

(4)
Kasa, Walker, Whiteman (REStud, 2014) can write equilibrium as

\[ p_t = p_t^{pf} - \kappa p_t^1 - (1 - \kappa) p_t^2 - p_t^{HOB} \]  

(5)
3.3 Return Predictability

Another widely documented failure of linear present value models is the ability to predict excess returns, which in the case of a constant discount rate, just means the ability to predict returns themselves.

Initially, excess volatility and return predictability were thought to be distinct puzzles. However, it is now well known that they are two sides of the same coin [Cochrane (2001) and Shiller (1989)]. In fact, a finding of excess volatility can be interpreted as long (i.e., infinite) horizon return predictability. Both puzzles are driven by the violation of the model’s implied orthogonality conditions. Still, it is useful to show how and why this occurs even in the case of one-period returns.

Of course, by construction the model’s orthogonality condition is satisfied. The equilibrium pricing functions were computed by imposing this condition. However, this is not the condition the econometrician is testing. He is falsely assuming that everyone has the same expectation. Although average expectations of returns are indeed zero, our econometrician does not observe the underlying shocks that generate these expectations, so he cannot test this prediction of the model. Instead, he uses the Wold representation in (3.1) to construct what he (falsely) believes is the market’s expectation of next period’s price. The Wold representation is a subset of the information available to the traders and therefore the econometrician’s projection of excess returns on his time information set will not display orthogonality.

Define the excess return as $R_{t+1} = \beta E_t p_{t+1} + f_t - p_t$, where the expectation is taken with respect to the Econometrician’s information set given by the Wold representation (3.1). Predictability suggests that if we regress $R_t$ onto lagged information, we should find statistically significant coefficients. The following result summarizes what our econometrician would find.

Proposition 4: Given Assumption 1, and assuming a symmetric equilibrium (i.e., $\kappa = 0.5$), see Koijen and Van Nieuwerburgh (2010) for a recent review of the literature.
Final Points

- Update empirical sections to reflect recent literature
- Focus more on asymmetries
- Connect theory more to structural model of Merton
- Isolate (minimize?) contribution of noise
- Solid paper