Default Risk, Shareholder Advantage, and Stock Returns

Lorenzo Garlappi  Tao Shu  Hong Yan
U. of Texas–Austin  U. of Texas–Austin  U. of Texas–Austin and SEC

Third Credit Risk Conference
Moody’s Corporation & The Salomon Center, NYU Stern
May 16, 2006
Motivating Questions

1. Q: How should default risk affect equity returns?

   A: With a proper measure of default risk,

   \[ \uparrow \text{default risk} \Rightarrow \uparrow \text{expected return} \]

2. Q: What is the empirical evidence on this relationship?

   A: Pervasive evidence:

   \[ \uparrow \text{default probability} \not\Rightarrow \uparrow \text{expected returns} \]

3. Q: Is this an arbitrage opportunity? Or is it attributable to some overlooked economic mechanisms?
Objective

**Understand** the link: default probability $\leftrightarrow$ equity returns. **Three steps:**

1. Revisit empirical evidence using a unique dataset from Moody’s KMV (EDF™) as a default probability indicator.

2. Use a **contingent claim valuation model** that allows for **shareholders’ advantage** in distressed firms.
   - **shareholder advantage**: ability of shareholders to extract rents in renegotiation with other claim-holders in the event of financial distress (e.g., APR violations).

3. **Empirically test** cross-sectional predictions of the model.
Preview of Results

1. Using Moody’s KMV EDF measure, we confirm:
   
   High default probability \(\not\Rightarrow\) High future returns

2. Using the valuation model with shareholder advantage, we show:
   
   ▶ Recovery for shareholders upon default alters equity risk
   ▶ Empirical predictions (consistent with risk/return trade-off):
     
     Shareholder advantage \(\uparrow\)

     \[
     \begin{align*}
     &1. \text{ Returns vs. EDF } \downarrow \text{ or } \nearrow \\
     &2. \text{ Returns given EDF } \downarrow
     \end{align*}
     \]

3. Using proxies for shareholder advantage, we confirm the predictions
Previous Evidence

► **Dichev (1998)**
  - High Olsen’s ‘O’ or low Altman’s ‘Z’ $\rightarrow$ low future returns

► **Griffin and Lemmon (2002)**
  - Low B/M and high ‘O’ $\rightarrow$ low future returns

► **Campbell, Hilscher and Szilagyi (2005)**
  - Use a hazard model to construct default probability
  - Find that high default probability $\rightarrow$ low future returns

► **Vassalou and Xing (2004)**
  - Construct an EDF-mimicking measure for default probability
  - Conclude that default risk is positively priced
Data

▶ **Moody’s KMV EDF: Expected Default Frequency**
  - Inspired by the Black-Scholes-Merton Model (Kealhofer (2003))
  - Time period: January 1969–December 2003
  - Number of observations: 1,430,713 firm-month
  - No financial firms

▶ **CRSP**
  - Equity Returns

▶ **COMPUSTAT**
  - Accounting variables


## Evidence from Moody’s KMV EDF (Table 2)

<table>
<thead>
<tr>
<th></th>
<th>Low EDF</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>High-Low</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raw returns</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EW</td>
<td>1.14</td>
<td>1.23</td>
<td>1.26</td>
<td>1.25</td>
<td>1.65</td>
<td>0.51</td>
<td>1.50</td>
</tr>
<tr>
<td>VW</td>
<td>0.96</td>
<td>1.11</td>
<td>1.08</td>
<td>0.95</td>
<td>0.82</td>
<td>-0.14</td>
<td>-0.38</td>
</tr>
<tr>
<td>DGTW-adjusted returns</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EW</td>
<td>0.03</td>
<td>0.08</td>
<td>0.08</td>
<td>0.09</td>
<td>0.74</td>
<td>0.72</td>
<td>2.95</td>
</tr>
<tr>
<td>VW</td>
<td>-0.01</td>
<td>0.07</td>
<td>-0.02</td>
<td>-0.18</td>
<td>-0.23</td>
<td>-0.22</td>
<td>-0.84</td>
</tr>
</tbody>
</table>

- EW ≠ VW even after DGTW adjustment!

- Possible cross-sectional variation in the relation Returns vs. EDF
Shareholder Advantage in Default: Basic mechanism

- **Equity** = **Call Option** on firm’s asset value

- **Default ≠ liquidation**: Chapter 11 filings and APR deviations

- Black-Merton-Scholes contingent claim framework with
  - Endogenous default
  - Non-zero expected payoff to shareholder upon default

- Shareholder advantage captures different cash-flow realizations.
  - NOT a new pricing factor!
Equity Payoff without Shareholder Advantage

\[ E_T = \max[V_T - D, 0] \]
Equity Payoff with Shareholder Advantage

Equity payoff $\propto$ assets if APR violations in default
Research Design

1. Start from existing valuation models of strategic debt service
   Anderson and Sundaresan (1996), Mella-Barral and Perraudin (1997), Fan and
   Sundaresan (2000), François and Morellec (2004), Acharyam, Huang, Subrah-
   manyam and Sundaram (2004)

2. Derive equity returns and default probabilities within the model

3. Simulate data from the model

4. Analyze the effect of shareholder advantage on simulated data

5. Use the model insights to design empirical tests on true data
Example: Fan and Sundaresan (2000) model

- Valuation model with **endogenous default** and **renegotiation**

\[ V : \text{given} \text{ asset value;} \quad \tilde{E}(V) = \tilde{\theta}V, \quad \tilde{D}(V) = (1 - \tilde{\theta})V, \]

- \( \tilde{\theta} \) sharing rule, from a **Nash bargaining game**:

\[
\tilde{\theta}^* = \arg \max \left[ \tilde{\theta}V - 0 \right]^{\eta} \cdot \left[ (1 - \tilde{\theta})V - (1 - \alpha)V \right]^{1-\eta} = \eta \alpha
\]

\[ \eta: \text{Shareholder bargaining power} \quad \alpha: \text{Liquidation cost} \quad \\} \quad \text{Shareholder Advantage (ADV)} \]

- Closed-form expressions for **equity returns** and **default probability**
Simulations

Role of shareholder Bargaining Power ($\eta$)

$\eta = 0, \alpha$

![Graph showing expected returns vs. probability of default quintiles]
Simulations

Role of shareholder Bargaining Power ($\eta$)

$\eta = 0$, $\alpha$

$\alpha = 0.5$

Expected returns

Probability of default quintiles

Probability of default quintiles
Simulations

Role of Liquidation Costs ($\alpha$)

$\eta = 0.5$
Testable Implications from the Model

► **Hypothesis 1.** The relationship between default probability and expected return should be

- **Upward-sloping** for firms with **minimal** shareholder advantage
- **Downward sloping and hump-shaped** for firms with **substantial** shareholder advantage.

► **Hypothesis 2.** For a **given** default probability the expected return should be **lower** for firms in which

- shareholders have **stronger** bargaining power and/or
- the economic gains from renegotiation are **larger**.
Empirical Proxies - Shareholders’ Bargaining Power

1. Asset size  

   ► **Information Asymmetry.** Small firms tend to have more concentrated creditors (Diamond (1991) and Sufi (2005))

   ► **Moral Hazard.** Large borrowers in default have better bargaining position.

2. R&D expenditures/assets

   ► **Empirically.** High R&D expenditure makes firm susceptible to cash flow constraints (Opler and Titman (1994))

   ► **Theoretically.** Cash flow-based covenants (Fan and Sundaresan (2000))
Empirical Proxies - Liquidation Costs

1. Herfindahl Index of sales \((↑ ⇒ ADV ↑)\)
   - Indirect measure of asset specificity
   - High Industry concentration → High likelihood of “fire sale”
     → high liquidation cost (Shleifer and Vishny (1992))

2. Asset Tangibility \((↑ ⇒ ADV ↓)\)
   - Direct measure of asset specificity
   - Asset liquidation value (Berger, Ofek and Swary (1996))
     \[ Tang = \text{Cash} + 0.715 \times \text{Receivables} + 0.547 \times \text{Inventory} + 0.535 \times \text{Capital} \]

3. Book-to-Market Ratio \((↓ ⇒ ADV ↑)\)
   - Loss of intangible assets in liquidation → Scope for bargaining
Empirical Predictions

Shareholder advantage (ADV) \uparrow

\begin{align*}
1. \text{Returns vs. EDF} & \downarrow \text{or} \curvearrowright \\
2. \text{Returns given high EDF} & \downarrow 
\end{align*}

Empirical Methodology

- Sub-portfolio analysis
- Regression analysis
### Hypothesis 1: Returns vs. EDF

<table>
<thead>
<tr>
<th>DGTW-adjusted returns (% per month)</th>
<th>( \text{ret}^{\text{high EDF}} - \text{ret}^{\text{low EDF}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>High ADV</td>
<td>Low ADV</td>
</tr>
<tr>
<td>Diff.</td>
<td></td>
</tr>
<tr>
<td>(−)</td>
<td>(+)</td>
</tr>
<tr>
<td>(−)</td>
<td></td>
</tr>
</tbody>
</table>

#### Bargaining power

- Asset Size: \(-1.02^* 0.73^* -1.74^{***}\)
- R&D expenditures: \(-0.42 0.78^* -1.19^{***}\)

#### Liquidation costs

- Industry concentration: \(-0.59^{**} -0.02 -0.57^*\)
- Asset tangibility: \(-0.46 0.30 -0.76^{**}\)
- Book-to-Market ratio: \(-0.91^{**} 0.34 -1.24^{***}\)

\( (*, **, *** = \text{significant at 10\%, 5\%, 1\%})\)
Summary of Results from Sub-Portfolio Analysis

Hypothesis 2: Returns given EDF

DGTW-adjusted returns (% per month)

<table>
<thead>
<tr>
<th></th>
<th>ret\textsuperscript{high ADV} − ret\textsuperscript{low ADV}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low EDF</td>
<td>(−/0)</td>
</tr>
<tr>
<td>High EDF</td>
<td>(−)</td>
</tr>
</tbody>
</table>

**Bargaining power**

- Asset Size         0.21   −1.54\(***\)
- R&D expenditures   −0.13   −1.32\(***\)

**Liquidation costs**

- Industry concentration −0.03   −0.60\(*\)
- Asset tangibility    −0.24\(*\)   −1.00\(***\)
- Book-to-Market ratio 0.13   −1.11\(***\)

\((*, **, *** = \text{significant at } 10\%, 5\%, 1\%))
Cross-Sectional Regression Analysis

(Table 9)

\[ R_i = F(\beta_i, \text{Size}_i, \text{BM}_i, \text{MOM}_i, \text{EDF}_i, X_i \ast \text{EDF}_i) \]

- \( \beta_i \): firm \( i \)’s beta
- \( \text{Size}_i \): asset size
- \( \text{BM}_i \): B/M ratio
- \( \text{MOM}_i \): past six-month returns
- \( \text{EDF}_i \): MKMV EDF measure
- \( X_i \): proxy for bargaining power/liquidation cost

- **Univariate** regression with each \( X_i \);

- **Multivariate** regression with all \( X_i \)’s.
<table>
<thead>
<tr>
<th>Models</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
<th>Model 6</th>
<th>Model 7</th>
<th>Model 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta</td>
<td>0.0001</td>
<td>-0.0024</td>
<td>-0.0007</td>
<td>-0.0011</td>
<td>-0.0008</td>
<td>-0.0019</td>
</tr>
<tr>
<td>t-stat</td>
<td>0.08</td>
<td>-1.86</td>
<td>-0.50</td>
<td>-0.88</td>
<td>-0.62</td>
<td>-1.49</td>
</tr>
<tr>
<td>Ln(AVL)</td>
<td>0.0005</td>
<td>-0.0012***</td>
<td>-0.0017***</td>
<td>-0.0017***</td>
<td>-0.0019***</td>
<td>0.0011**</td>
</tr>
<tr>
<td>t-stat</td>
<td>1.25</td>
<td>-3.02</td>
<td>-4.18</td>
<td>-4.28</td>
<td>-4.33</td>
<td>2.32</td>
</tr>
<tr>
<td>Ln(BM)</td>
<td>0.0047***</td>
<td>0.0053***</td>
<td>0.0044***</td>
<td>0.0045***</td>
<td>0.0023**</td>
<td>0.0040***</td>
</tr>
<tr>
<td>t-stat</td>
<td>5.94</td>
<td>7.42</td>
<td>5.37</td>
<td>5.98</td>
<td>2.12</td>
<td>3.89</td>
</tr>
<tr>
<td>Ret(-6,-1)</td>
<td>0.0208*</td>
<td>0.0194*</td>
<td>0.0175</td>
<td>0.0166</td>
<td>0.0174</td>
<td>0.0193*</td>
</tr>
<tr>
<td>t-stat</td>
<td>1.86</td>
<td>1.75</td>
<td>1.54</td>
<td>1.50</td>
<td>1.48</td>
<td>1.75</td>
</tr>
<tr>
<td>EDF</td>
<td>0.1026***</td>
<td>-0.0107***</td>
<td>0.0040</td>
<td>-0.0154***</td>
<td>-0.0025</td>
<td>0.0855***</td>
</tr>
<tr>
<td>t-stat</td>
<td>5.62</td>
<td>-3.12</td>
<td>0.97</td>
<td>-3.98</td>
<td>-0.79</td>
<td>4.06</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>0.0001</td>
<td></td>
<td></td>
<td></td>
<td>0.0005**</td>
<td></td>
</tr>
<tr>
<td>t-stat</td>
<td>0.32</td>
<td></td>
<td></td>
<td></td>
<td>2.42</td>
<td></td>
</tr>
<tr>
<td>Hfdl</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.0007***</td>
<td></td>
</tr>
<tr>
<td>t-stat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.74</td>
<td></td>
</tr>
<tr>
<td>Tang</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.0006***</td>
<td></td>
</tr>
<tr>
<td>t-stat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-2.98</td>
<td></td>
</tr>
<tr>
<td>Ln(AVL)×EDF</td>
<td>-0.0058</td>
<td></td>
<td></td>
<td></td>
<td>-0.0051</td>
<td>***</td>
</tr>
<tr>
<td>t-stat</td>
<td>-6.14</td>
<td></td>
<td></td>
<td></td>
<td>-4.86</td>
<td></td>
</tr>
<tr>
<td>R&amp;D×EDF</td>
<td></td>
<td>0.0019***</td>
<td></td>
<td></td>
<td>0.0031**</td>
<td></td>
</tr>
<tr>
<td>t-stat</td>
<td></td>
<td>4.44</td>
<td></td>
<td></td>
<td>2.04</td>
<td></td>
</tr>
<tr>
<td>Hfdl×EDF</td>
<td></td>
<td></td>
<td>-0.0016***</td>
<td></td>
<td>-0.0007*</td>
<td></td>
</tr>
<tr>
<td>t-stat</td>
<td></td>
<td></td>
<td>-5.28</td>
<td></td>
<td>-1.85</td>
<td></td>
</tr>
<tr>
<td>Tang×EDF</td>
<td></td>
<td></td>
<td></td>
<td>0.0021***</td>
<td>0.0020***</td>
<td></td>
</tr>
<tr>
<td>t-stat</td>
<td></td>
<td></td>
<td></td>
<td>6.41</td>
<td>4.29</td>
<td></td>
</tr>
<tr>
<td>Ln(BM)×EDF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.0039***</td>
<td>0.0007*</td>
</tr>
<tr>
<td>t-stat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.06</td>
<td>1.92</td>
</tr>
<tr>
<td>Average Adj. $R^2$</td>
<td>0.0461</td>
<td>0.0548</td>
<td>0.0492</td>
<td>0.0471</td>
<td>0.0441</td>
<td>0.0575</td>
</tr>
</tbody>
</table>
Robustness Checks

► Returns over different holding periods (liquidity issues)

► Other proxies used in the literature for
  
  • Default probability
    ★ Z-score, O-score, and Shumway’s hazard model
  
  • Bargaining power
    ★ Managerial Shareholdings
    ★ Institutional Holdings
  
  • Liquidation cost
    ★ Non-fixed assets
    ★ Market-to-book assets
Conclusions

▶ Propose a novel economic explanation for the relationship:

\[
\text{Default risk} \rightarrow \text{Equity returns}
\]

that is based on shareholder advantage and is consistent with the risk-return trade-off

▶ Provide additional empirical support for the cross sectional predictions of the model

▶ Demonstrate the importance of shareholder advantage in strategic interactions among stakeholders for equity returns.