Credit Risk on Corporate Debt

0. Overview

- Global Debt Markets
- Yield Spreads
- Default and Recovery Rates
- Valuation
- Bond Ratings
- Registration Basics
- Credit Derivatives
- Interest Sensitivity Revisited
1. Global Debt Markets

Amounts outstanding, billions of US dollars, 1996:

<table>
<thead>
<tr>
<th></th>
<th>Amounts Outstanding</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Public Domestic Issues</strong></td>
<td></td>
</tr>
<tr>
<td>US</td>
<td>7.102</td>
</tr>
<tr>
<td>Japan</td>
<td>3.299</td>
</tr>
<tr>
<td>Germany</td>
<td>0.854</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>16.205</td>
</tr>
<tr>
<td><strong>Private Domestic Issues</strong></td>
<td></td>
</tr>
<tr>
<td>US</td>
<td>4.513</td>
</tr>
<tr>
<td>Japan</td>
<td>1.469</td>
</tr>
<tr>
<td>Germany</td>
<td>1.024</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>9.625</td>
</tr>
<tr>
<td><strong>International Issues</strong></td>
<td></td>
</tr>
<tr>
<td>US</td>
<td>0.403</td>
</tr>
<tr>
<td>Japan</td>
<td>0.357</td>
</tr>
<tr>
<td>Germany</td>
<td>0.342</td>
</tr>
<tr>
<td>Emerging Markets</td>
<td>0.276</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3.226</td>
</tr>
<tr>
<td><strong>International Issues by Currency</strong></td>
<td></td>
</tr>
<tr>
<td>Dollars</td>
<td>1.246</td>
</tr>
<tr>
<td>Yen</td>
<td>0.518</td>
</tr>
<tr>
<td>Deutschemarks</td>
<td>0.347</td>
</tr>
<tr>
<td>Pounds</td>
<td>0.237</td>
</tr>
<tr>
<td>Swiss Francs</td>
<td>0.166</td>
</tr>
</tbody>
</table>

Source: IMF.
2. Yield Spreads for US Corporates

Aa and Baa spreads over Aaa, 1970-1997:

Source: Moody’s, yields on generic corporates.
2. Yield Spreads for US Corporates (continued)

- Yield spreads over Aaa (BPs):

<table>
<thead>
<tr>
<th>Rating</th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aa</td>
<td>32</td>
<td>16</td>
</tr>
<tr>
<td>A</td>
<td>64</td>
<td>35</td>
</tr>
<tr>
<td>Baa</td>
<td>114</td>
<td>45</td>
</tr>
</tbody>
</table>

- Remarks:
  - Credit risk is apparently the major factor
  - Liquidity plays a role, too
  - Spreads highly variable
3. Spot Rate Spreads

- Reminder: yields depend on maturity and coupon
- Spreads for spot rates (1986-97):
3. Spot Rate Spreads (continued)

Average spreads over treasuries (1986-97, BPs):

<table>
<thead>
<tr>
<th>Maturity (Yrs)</th>
<th>Aa</th>
<th>A</th>
<th>Baa</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>38</td>
<td>65</td>
<td>127</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>72</td>
<td>132</td>
</tr>
<tr>
<td>3</td>
<td>47</td>
<td>75</td>
<td>133</td>
</tr>
<tr>
<td>4</td>
<td>52</td>
<td>80</td>
<td>135</td>
</tr>
<tr>
<td>5</td>
<td>58</td>
<td>84</td>
<td>137</td>
</tr>
<tr>
<td>6</td>
<td>62</td>
<td>88</td>
<td>139</td>
</tr>
<tr>
<td>7</td>
<td>66</td>
<td>91</td>
<td>140</td>
</tr>
<tr>
<td>8</td>
<td>70</td>
<td>93</td>
<td>141</td>
</tr>
<tr>
<td>9</td>
<td>72</td>
<td>95</td>
<td>142</td>
</tr>
<tr>
<td>10</td>
<td>74</td>
<td>96</td>
<td>143</td>
</tr>
</tbody>
</table>

Source: Elton, Gruber, and Mann (preliminary!)
4. Default and Recovery Rates

- Default rates (%), 1970-96:

<table>
<thead>
<tr>
<th>Rating</th>
<th>1-Year</th>
<th>5-year</th>
<th>10-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aaa</td>
<td>0.00</td>
<td>0.13</td>
<td>0.74</td>
</tr>
<tr>
<td>Aa</td>
<td>0.03</td>
<td>0.40</td>
<td>1.13</td>
</tr>
<tr>
<td>A</td>
<td>0.01</td>
<td>0.57</td>
<td>1.73</td>
</tr>
<tr>
<td>Baa</td>
<td>0.12</td>
<td>1.71</td>
<td>4.61</td>
</tr>
<tr>
<td>Ba</td>
<td>1.36</td>
<td>11.57</td>
<td>20.94</td>
</tr>
<tr>
<td>B</td>
<td>7.27</td>
<td>29.45</td>
<td>44.31</td>
</tr>
</tbody>
</table>

Source: Moody’s.

- Recovery rates (%), 1989-96:

<table>
<thead>
<tr>
<th>Security</th>
<th>Average Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Senior Secured Debt</td>
<td>63</td>
</tr>
<tr>
<td>Senior Unsecured Debt</td>
<td>48</td>
</tr>
<tr>
<td>Senior Subordinated Debt</td>
<td>38</td>
</tr>
<tr>
<td>Subordinated Debt</td>
<td>28</td>
</tr>
<tr>
<td>All Public Debt</td>
<td>41</td>
</tr>
</tbody>
</table>

Source: Moody’s.
4. Default and Recovery Rates (continued)

Annual US corporate default rates:
5. Rating Drift

- Summary: ratings typically drift down

- 1-year rating changes (%), 1970-93:

<table>
<thead>
<tr>
<th>Current Rating</th>
<th>Aaa</th>
<th>Aa</th>
<th>A</th>
<th>Baa</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aaa</td>
<td>89.6</td>
<td>7.2</td>
<td>0.7</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Aa</td>
<td>1.1</td>
<td>88.8</td>
<td>6.9</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>A</td>
<td>0.1</td>
<td>2.5</td>
<td>89.0</td>
<td>5.2</td>
<td>0.8</td>
</tr>
<tr>
<td>Baa</td>
<td>0.0</td>
<td>0.2</td>
<td>5.2</td>
<td>85.3</td>
<td>6.4</td>
</tr>
</tbody>
</table>

- 5-year rating changes (%), 1970-93:

<table>
<thead>
<tr>
<th>Current Rating</th>
<th>Aaa</th>
<th>Aa</th>
<th>A</th>
<th>Baa</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aaa</td>
<td>62.5</td>
<td>21.8</td>
<td>4.9</td>
<td>0.5</td>
<td>1.2</td>
</tr>
<tr>
<td>Aa</td>
<td>5.5</td>
<td>52.9</td>
<td>22.3</td>
<td>3.9</td>
<td>2.7</td>
</tr>
<tr>
<td>A</td>
<td>0.3</td>
<td>9.9</td>
<td>59.6</td>
<td>15.0</td>
<td>5.8</td>
</tr>
<tr>
<td>Baa</td>
<td>0.2</td>
<td>1.9</td>
<td>18.8</td>
<td>49.7</td>
<td>17.8</td>
</tr>
</tbody>
</table>

Source: Altman.

NB: Totals don’t sum to one (some ratings are withdrawn).
6. Evidence Wrap-Up

- Observations:
  - Spreads large and variable
  - Spreads increase with maturity
  - Ratings drift down (on average)
  - Defaults bunched in time (not diversifiable?)

- Inference: spreads reflect
  - Default probabilities
  - Recovery rates
  - Risk premiums
7. Risk and Return (CAPM Review)

- Returns: $r_f$ is the riskfree return, $r_m$ the return on the market, and $r_i$ the return on an arbitrary asset

- Expected returns:

$$E(r_i) = r_f + \beta_i [E(r_m) - r_f]$$
$$= r_f + \pi_i$$

(think of $\pi_i$ as the risk premium on asset $i$)

- Valuation of asset $i$:

$$\text{Price} = \frac{\text{Expected Cash Flow}}{1 + r_f + \pi_i}$$

(one-period example, but you get the idea)

- Summary: value based on expected cash flow, but the discount rate is adjusted for risk ($\pi_i$)

- Remark: similar result applies in more general settings (ie, beyond the CAPM, including our state-contingent claims models)
8. Corporate Bond Analytics

- Impact of default, recovery, and risk on yield spreads
- One period bonds (practice)
- Notation:
  \[ \alpha = \text{Prob(Solvency)} = 1 - \text{Prob(Default)} \]
  \[ \beta = \text{Recovery Rate} \]
- Expected cash flow from one dollar face value:
  \[ E(\text{Cash Flow}) = 1 \times [\alpha + (1 - \alpha)\beta] \]
- Valuation:
  \[ \text{Corp Disc Factor} = \frac{1}{1 + (y + \pi)/2} \times [\alpha + (1 - \alpha)\beta] \]
  \[ = \frac{1}{1 + (y + s)/2} \]
  where \( y \) is the riskfree (treasury) spot rate, \( \pi \) the risk premium, and \( s \) the appropriate corporate spread
- Remark: the spread \( s \) captures the effects of default (\( \alpha \)), recovery (\( \beta \)), and risk (\( \pi \))
8. Corporate Bond Analytics (continued)

- Example:

\[ \alpha = 0.99 \]
\[ \beta = 0.50 \]
\[ \pi = 0.01 \]
\[ y = 6\% \]

- Calculations:

\[ E(\text{Cash Flow}) = 0.995 \]
\[ \text{Treas Disc Factor} = 0.9709 \]
\[ \text{Corp Disc Factor} = 0.9614 \]
\[ s = 2.04\% \]
9. Interest Sensitivity of Corporates

- Yield is sum of two components:
  - Yield $y$ on comparable treasury
  - Spread $s$ over treasuries

- Sensitivity:
  - Duration (sensitivity to $y$):
    \[ D = -\frac{dp/dy}{p} \quad \text{(the usual calculation)} \]
  - Spread duration (sensitivity to $s$):
    \[ D_s = -\frac{dp/ds}{p} \quad \text{(the same number)} \]
  - Price changes:
    \[ \Delta p \approx -Dp\Delta y - D_s p\Delta s \]
  - Value-at-Risk (VAR) analyses include both components
9. **Interest Sensitivity of Corporates (continued)**

- Statistical properties of the spread
  (monthly changes, 1986-97):

  - Std dev of 5-year treas spot: 0.33%
  - Std dev of 5-year corp spread: 0.19%
  - Correlation: -0.31

  Source: Elton, Gruber, and Mann.

- Statistical approaches (CreditMetrics, CreditRisk+, etc)
  - Model spreads for each rating class
  - Allow for changes in rating, too
  - Subtle issue: correlation across bonds
10. Bond Rating Overview

- Rating agencies: Moody’s, Standard and Poors, Fitch, Duff and Phelps

- Ratings based on
  - Industry: how risky?
  - Firm’s status in industry
  - Financial situation
  - Management and accounting quality
  - Legal status: senior or subordinated, covenants

- Statistical approaches
  - Compute ratings from ratios of:
    * pretax earnings to interest payments (coverage)
    * working capital to total assets
    * retained earnings to total assets
    * operating income to total assets
    * book value of equity to total assets (leverage)
  - Estimation by a variety of statistical methods
  - Modifications dictated by data availability
    (eg, private firms and emerging markets)
11. SEC Registration Basics

- Public issues in the US must be registered with the SEC under the 1933 Act:
  - Clear registration statement with SEC
  - File and distribute prospectus

- Failure to register when called for gives the buyer a put

- Shelf registration: Rule 415 allows a firm to register a security once, then issue or reissue within two years at its convenience (medium term notes are a good example)

- Exemptions from registration:
  - Reg 144A: sales to Qualified Institutional Buyers (QIBs)
  - Reg S: ditto off-shore sales to non-US buyers
  - Private placements: some debt is placed directly
  - Issues with maturities under 180 days (paper)

- Disclosure applies to all: even when registration isn’t required, fraud laws and investor due diligence generally require borrowers to disclose relevant information
12. Structured Financing Overview

- Securitization:
  - Issuer sells loans (or other assets) to “single-purpose vehicle (SPV),” typically a trust, legally separate from the issuer
  - SPV issues securities using the loans as collateral
  - Examples: mortgages, credit card debts, auto loans
  - Simplest version is a passthrough: owners of securities get cash flows of loans (net of a servicing fee)
  - Advantages:
    * Issuer (a bank, say) unloads the capital charges associated with holding the loans
    * Securities generally more liquid than the loans
    * Allows specialization: originator, servicer, and investor can be different
    * Structuring: SPV can issue different classes of securities that appeal to different investors (“tranches”)
    * Overcollaterization can support higher rating on security than on the underlying loans
12. Structured Financing Overview (continued)

- Collaterized Bond Obligations (CBOs)
  - SPV buys bonds, typically with low average rating
  - SPV finances bonds by issuing securities

Illustrative example:
* 70% (say) Aa-rated notes at Treas + 35 BPs
* 15% Baa-rated notes at Treas + 200 BPs
* 15% equity (residuals)

- Advantages:
  * Diversification: portfolio less risky than pieces
  * Transforms junk into investment grade
  * Allows junk issuers to tap investment grade market
  * Sharp discount on junk makes this profitable
  * Leverage: equity investors (the issuer?) have highly-levered position in underlying bonds
    (moreover, often treated better by regulators than equivalent positions in underlying assets)
13. Credit Derivatives

- Market forces:
  - Institutions want to diversify credit exposure
    * Example: bank has large exposure to important client, wants to reduce credit exposure (and capital requirements) without jeopardizing relationship
  - Investors want direct access to credit risk
    * Example: Pension fund wants exposure to credit risk on Brady bonds without additional exposure to interest rates

- Problems:
  * Underlying assets hard to trade
  * ... and contain other risks

- Possible solution: credit derivatives
13. Credit Derivatives (continued)

Examples

- Default swap or put
  - Investor pays (say) fixed annual premium
  - Dealer pays difference between par and market price if default occurs (investor has a put option)
  - Remark: similar to bond insurance

- Total return swap
  - Counterparty 1 pays LIBOR + spread
  - Counterparty 2 pays total return on loan pool
  - Result: 1 has assumed 2’s credit exposure
  - Variants: replace loan pool with corporate bonds, Brady bonds, municipals, or sovereigns, either individually or in “baskets” (hence the various bond indexes)

- Credit spread swap
  - Investor pays yield on a specific corporate bond
  - Dealer pays treasury yield + spread
  - Result: Investor gains exposure to corporate credit risk
13. Credit Derivatives (continued)

ABC Corp in the mid-80s (several mergers ago)

- **Situation:**
  - Rumors of hostile takeover triggered increase in spread on ABC debt
  - ABC regarded rumors unfounded

- **Plan:**
  - ABC and an investment partner purchased ABC’s debt
  - Partnership agreement assessed changes in value due to credit risk to ABC, changes due to market yields to partner

- **Result:**
  - ABC’s credit spread tightened, earning ABC several million dollars
13. Credit Derivatives (continued)

- Outstanding issues:
  - Documentation: no ISDA standard agreement yet
    * Greater legal burdens in writing contracts
    * Uncertain treatment by courts
  - Lack of standardization hurts liquidity
  - Uncertain verification of credit events
  - Regulatory treatment: when is a hedge counted?
  - International differences in default/bankruptcy law
Summary

- Corporate debt trades at lower prices (higher yields) than treasuries with comparable cash flows

- Standard interpretation: credit risk

- Valuation has three components: default rates, recovery rates, and risk premiums

- Bond ratings are professional assessments of credit risk

- Credit risk is an extra ingredient in fixed income portfolios and is generally modeled as an extra factor (the spread)

- CBOs and credit derivatives are useful tools for managing credit risk