The role of rating philosophy at calculation of credit measures

Miklos Veber

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How philosophy comes into the picture?
What is rating?

Rating needs to reflect the riskiness/creditworthiness of a counterparty as well as to provide a qualitative assessment about the probability of default.
## How to measure creditworthiness?

<table>
<thead>
<tr>
<th>Moody's</th>
<th>Standard &amp; Poor's</th>
<th>Fitch</th>
<th>AM Best</th>
<th>Credit worthiness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aaa</td>
<td>AAA</td>
<td>AAA</td>
<td>aaa</td>
<td>An obligor has EXTREMELY STRONG capacity to meet its financial commitments.</td>
</tr>
<tr>
<td>Aa1</td>
<td>AA+</td>
<td>AA+</td>
<td>aa+</td>
<td>An obligor has VERY STRONG capacity to meet its financial commitments. It differs from the highest rated obligors only in small degree.</td>
</tr>
<tr>
<td>Aa2</td>
<td>AA</td>
<td>AA</td>
<td>aa</td>
<td></td>
</tr>
<tr>
<td>Aa3</td>
<td>AA-</td>
<td>AA-</td>
<td>aa-</td>
<td></td>
</tr>
<tr>
<td>A1</td>
<td>A+</td>
<td>A+</td>
<td>a+</td>
<td>An obligor has STRONG capacity to meet its financial commitments but is somewhat more susceptible to the adverse effects of changes in circumstances and economic conditions than obligors in higher-rated categories.</td>
</tr>
<tr>
<td>A2</td>
<td>A</td>
<td>A</td>
<td>a</td>
<td></td>
</tr>
<tr>
<td>A3</td>
<td>A-</td>
<td>A-</td>
<td>a-</td>
<td></td>
</tr>
<tr>
<td>Baa1</td>
<td>BBB+</td>
<td>BBB+</td>
<td>bbb+</td>
<td>An obligor has ADEQUATE capacity to meet its financial commitments. However, adverse economic conditions or changing circumstances are more likely to lead to a weakened capacity of the obligor to meet its financial commitments.</td>
</tr>
<tr>
<td>Baa2</td>
<td>BBB</td>
<td>BBB</td>
<td>bbb</td>
<td></td>
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<tr>
<td>Baa3</td>
<td>BBB-</td>
<td>BBB-</td>
<td>bbb-</td>
<td></td>
</tr>
<tr>
<td>Ba1</td>
<td>BB+</td>
<td>BB+</td>
<td>bb+</td>
<td>An obligor is LESS VULNERABLE in the near term than other lower-rated obligors. However, it faces major ongoing uncertainties and exposure to adverse business, financial, or economic conditions which could lead to the obligor’s inadequate capacity to meet its financial commitments.</td>
</tr>
<tr>
<td>Ba2</td>
<td>BB</td>
<td>BB</td>
<td>bb</td>
<td></td>
</tr>
<tr>
<td>Ba3</td>
<td>BB-</td>
<td>BB-</td>
<td>bb-</td>
<td></td>
</tr>
<tr>
<td>B1</td>
<td>B+</td>
<td>B+</td>
<td>b+</td>
<td>An obligor is MORE VULNERABLE than the obligors rated ‘BB’, but the obligor currently has the capacity to meet its financial commitments. Adverse business, financial, or economic conditions will likely impair the obligor’s capacity or willingness to meet its financial commitments.</td>
</tr>
<tr>
<td>B2</td>
<td>B</td>
<td>B</td>
<td>b</td>
<td></td>
</tr>
<tr>
<td>B3</td>
<td>B-</td>
<td>B-</td>
<td>b-</td>
<td></td>
</tr>
<tr>
<td>Caa</td>
<td>CCC</td>
<td>CCC</td>
<td>ccc</td>
<td>An obligor is CURRENTLY VULNERABLE, and is dependent upon favourable business, financial, and economic conditions to meet its financial commitments.</td>
</tr>
<tr>
<td>Ca1</td>
<td>CC</td>
<td>CC</td>
<td>cc</td>
<td>An obligor is CURRENTLY HIGHLY-VULNERABLE.</td>
</tr>
<tr>
<td>C</td>
<td>C</td>
<td>C</td>
<td>c</td>
<td>The obligor is CURRENTLY HIGHLY-VULNERABLE to nonpayment. May be used where a bankruptcy petition has been filed.</td>
</tr>
<tr>
<td>C</td>
<td>D</td>
<td>D</td>
<td>d</td>
<td>An obligor has failed to pay one or more of its financial obligations (rated or unrated) when it became due.</td>
</tr>
<tr>
<td>e, p</td>
<td>pr</td>
<td>Expected</td>
<td>preliminary ratings may be assigned to obligations pending receipt of final documentation and legal opinions. The final rating may differ from the preliminary rating.</td>
<td></td>
</tr>
<tr>
<td>WR</td>
<td>unsolicited</td>
<td>unsolicited</td>
<td>Rating withdrawn for reasons including: debt maturity, calls, puts, conversions, etc., or business reasons (e.g. change in the size of a debt issue), or the issuer defaults.</td>
<td></td>
</tr>
<tr>
<td>unsolicited</td>
<td>SD</td>
<td>RD</td>
<td>This rating was initiated by the ratings agency and not requested by the issuer.</td>
<td></td>
</tr>
<tr>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>No rating has been requested, or there is insufficient information on which to base a rating.</td>
<td></td>
</tr>
</tbody>
</table>
Why is it difficult to assess the riskiness/probability of default (PD)?

Most of the rating agencies try to smooth out the fluctuations:
- Point-in-time metrics: no smoothing at all
- Through-the-cycle metrics: removal of cyclicality

Source: S&P: Ratings Criteria, 2006
Structural model of EDF* ($\approx$ PD) by Moodys:

*EDF = Expected Default Frequency

Source: Moody's Analytics: Through-the-Cycle EDF Credit Measures
Definition of Distance-to-Default (DD):

\[ DD \approx \frac{\ln(A) - \ln(X)}{\sigma} \]

Where:
- \( A \) = Asset value
- \( X \) = Notional value of liabilities (default point)
- \( \sigma \) = volatility of the asset distribution
Relationship between EDF/PD and DD:

DD = 4 maps to a 0.003% PD in the simple BSM model, but to a 0.4% EDF™ metric

Source: Moody’s Analytics: Through-the-Cycle EDF Credit Measures
Our main purpose: getting TTC estimate from PIT one

Removal of:
- Business cycles (measured by aggregated output of the economy, like GDP)
- Credit cycles (fluctuations in loan supply, etc)

Source: Moody’s Analytics: Through-the-Cycle EDF Credit Measures
Planned estimation process:

Source: Moody’s Analytics: Through-the-Cycle EDF Credit Measures
Step 1 - Estimate Trend DD:

Source: Moody’s Analytics: Through-the-Cycle EDF Credit Measures
Hodrick-Prescott (HP) filter:

Observations contain a trend ($\tau$) and cyclical ($c$) component:

$$y_t = \tau_t + c_t$$

We need to minimize the following expression:

$$\min_{\tau_t} \sum_{t=1}^{T} (y_t - \tau_t)^2 + \lambda \sum_{t=2}^{T-1} [(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2$$

Parameter $\lambda$ determines the smoothing intensity:

- If $\lambda \to \infty$: linear regression
- If $\lambda = 0$: original time series will be kept
Determination of the \( \lambda \) parameter (1)

With empirical analysis on the average de-trended (linear trend is removed) avg EDF figures of North-American firms:

\[
y_t = a + b \cos\left(\frac{2\pi}{111}(t - 55)\right)
\]

Source: Moody’s Analytics: Through-the-Cycle EDF Credit Measures
Determination of the $\lambda$ parameter (2)

With spectral analysis - periodogram

- Primary peak at 9 years: NBER major cycle
- Secondary peak at 4.5 years: NBER minor cycle
Determination of the $\lambda$ parameter (3)

After application of the (confidential) $\lambda$ parameter:

Source: Moody’s Analytics: Through-the-Cycle EDF Credit Measures
Step 2 - Regress Trend DD on DD:

Source: Moody’s Analytics: Through-the-Cycle EDF Credit Measures
Linear regression for long history firms:

For each firm $i$, we identify two parameters $\hat{\alpha}_i$ and $\hat{\beta}_i$ such that

$$DD_{it}^{TTC} \equiv \hat{\alpha}_i + \hat{\beta}_i DD_{it}, \quad t = 1, 2, \ldots, T$$

where the parameters are estimated from the following regression equation

$$DD_{it}^{trend} = \alpha_i + \beta_i DD_{it} + \epsilon_{it}, \quad t = 1, 2, \ldots, T$$

Source: Moody’s Analytics: Through-the-Cycle EDF Credit Measures
Linear regression for short history firms:

\[ DD_{t}^{trend} = \alpha + \beta DD_{t} \]

If we introduce the following notation:

\[ \mu = \frac{\alpha}{1 - \beta} \]

Let us refer to this \( \mu \) as crossover point going forward. With this notation we will get:

\[ DD_{t}^{trend} - \mu = \beta (DD_{t} - \mu) \]
Linear regression for short history firms:

Instead of regressing $\alpha$ and $\beta$, we will regress $\beta$ and the crossover point with the following regression:

$$xover_i = \theta_0 + \sum_{k=2}^{17} \theta_k \text{sector}_{ik} + \theta_{18} \text{size}_i + \theta_{19} \text{vol}_i + \theta_{20} \text{lev}_i + \epsilon_i$$

where $xover_i$ is the crossover point for firm $i$, and $\text{sector}_{ik}$ is the dummy variable set to 1 if firm $i$ is in sector $k$. To avoid multicollinearity among the dummy variables, dummies are set only for sectors 2 to 17. So $\theta_k$ captures the incremental impact of sector $k$ relative to sector 1. $\text{size}_i$ is the time-series average rank of firm $i$'s market capitalization, $\text{vol}_i$ is the time-series average rank of firm $i$'s asset volatility, and $\text{lev}_i$ is the time-series average rank of firm $i$'s degree of leverage, defined as the ratio of the firm's default threshold value.
Step 3 – Calculate TTC DD with help of the regression model:

\[ TTC\ DD = \alpha + \beta DD \]

Source: Moody’s Analytics: Through-the-Cycle EDF Credit Measures
Step 4 – Rescale TTC DD to TTC EDF:

Source: Moody’s Analytics: Through-the-Cycle EDF Credit Measures
Results – predictive power:

Source: Moody’s Analytics: Through-the-Cycle EDF Credit Measures
Results – Overall stability and model power:

Source: Moody’s Analytics: Through-the-Cycle EDF Credit Measures
Results – Type I and Type II Errors:

Source: Moody’s Analytics: Through-the-Cycle EDF Credit Measures
Results – Type I and Type II Errors:

Source: Moody’s Analytics: Through-the-Cycle EDF Credit Measures
Conclusions:

TTC EDF provided a risk metric, which:

- Shows lower volatility/fluctuation than the usual metrics
- Its accuracy ratio is also on an acceptable level (not significantly worse than PIT metrics)
- Its error profile is also acceptable
References:


• Moody’s Investors Service: Corporate Default and Recovery Rates, 1920-2010. Special Comment (February 2011)

• Moody’s Analytics: Through-the-Cycle EDF™ Credit Metrics (August 2011)

• Standard & Poor’s: Corporate Ratings Criteria (2006)