Combining Quantitative and Qualitative Approaches in Credit Risk Scoring

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Agenda

1. Quantitative Approach as the basis of a Rating Model
2. Capturing and Overlaying Qualitative Information
3. Weighting the two Approaches to Maximize Accuracy
Sources of information to assess company’s credit standing

Future / past situation of a company

Management

Financial statement credit rating

Company’s credit standing

Bank account data

Other subjective factors
Models, Scorecards and Other Approaches to Rating

- Pure Judgment
  - Potentially inconsistent within and across portfolios
  - No reliable link to expected loss.
  - Possibly accurate for rank ordering credits within a single portfolio.

- Template
  - Structuring of process for underwriter
  - Primary gain is consistency of approach within portfolio, less so across portfolios
  - Moderate link to probability of default and expected loss
  - Flexibility for nonstandard credits.

- Scorecard
  - Ultimate decision still with credit-qualified officer.
  - Consistent process and evaluation of risk within and across portfolios.
  - Can be calibrated to probability of default and expected losses.

- Pure Model
  - Intervention for exceptions only.
  - Can be calibrated to probability of default and expected losses
  - Can be used to prescreen databases
1. Quantitative Approach as the basis of a Rating Model
1. Quantitative Data as the basis of a Rating Model

A quantitative approach to credit risk provides a sound foundation for assessing credit risk

✓ Efficient
✓ Consistent
✓ Objective
✓ Testable
A Large and Good Quality Data Sample is Paramount

<table>
<thead>
<tr>
<th>Period</th>
<th>Number of Firms</th>
<th>Number of Defaults</th>
<th>Number of Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002-2009</td>
<td>290,000+</td>
<td>20,000</td>
<td>800,000</td>
</tr>
</tbody>
</table>

Combining Quantitative and Qualitative Approaches
Select relevant financial inputs

“Irrelevant” ratios

Density

Insolvent  Solvent

“relevant” ratios

Density

Insolvent  Solvent

Ratio

Ratio
# Financial inputs, ratios and weights in a PD model

<table>
<thead>
<tr>
<th>Russian Model Input List</th>
<th>Russian Model Ratio List</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash &amp; Marketable Securities</td>
<td>RE to Current Liabilities Net Worth to Total Assets</td>
<td>33.70%</td>
</tr>
<tr>
<td>Accounts Payable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Assets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Liabilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Liabilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retained Earnings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net Worth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sales</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Profit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net Income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LEVERAGE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GROWTH</td>
<td>Sales Growth</td>
<td>2.00%</td>
</tr>
<tr>
<td>PROFITABILITY</td>
<td>ROA</td>
<td>21.23%</td>
</tr>
<tr>
<td>ACTIVITY</td>
<td>Accounts Payables to Sales</td>
<td>18.16%</td>
</tr>
<tr>
<td>DEBT COVERAGE</td>
<td>Operating Profit to Total Liabilities</td>
<td>10.83%</td>
</tr>
<tr>
<td>LIQUIDITY</td>
<td>Cash to Total Assets</td>
<td>14.10%</td>
</tr>
</tbody>
</table>
Frequent Testing and Constant Monitoring

Power Curve 1-Year Model

- RiskCalc Russia v3.1: 64%
- Z-score: 48%
- P-Value of Difference: <.0001

Power Curve 5-Year Model

- RiskCalc Russia v3.1: 54%
- Z-score: 34%
- P-Value of Difference: <.0001
Combining Usage Data with RiskCalc EDF

Data is from eight US financial institutions

We collect usage information quarterly

We compute monthly EDF credit measures based on the latest available financial statement and credit cycle of that particular month

<table>
<thead>
<tr>
<th>Sample Description</th>
</tr>
</thead>
<tbody>
<tr>
<td># Quarters</td>
</tr>
<tr>
<td>355033</td>
</tr>
</tbody>
</table>

Usage level is higher for defaulted firms

Usage ratio is defined as total draw-down amount scaled by the total commitment amount

<table>
<thead>
<tr>
<th>Usage Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
</tr>
<tr>
<td>Non-Defaulter</td>
</tr>
<tr>
<td>Defaulter</td>
</tr>
</tbody>
</table>
Usage Information Helps Improve the Accuracy of Default Prediction

<table>
<thead>
<tr>
<th>Variable</th>
<th>AR</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDF only</td>
<td>53%</td>
</tr>
<tr>
<td>Usage only</td>
<td>39%</td>
</tr>
<tr>
<td>70% weight on EDF, 30% on Usage</td>
<td>57%</td>
</tr>
</tbody>
</table>
2. Capturing and Overlaying Qualitative Information
Qualitative Factors Compliment a Quantitative Model

The qualitative factors in a Scorecard are generally designed to be broad and general.

<table>
<thead>
<tr>
<th>Industry/Market</th>
<th>Balance Sheet Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry</td>
<td>Audit Method</td>
</tr>
<tr>
<td>Market Conditions</td>
<td>Inventory Valuation</td>
</tr>
<tr>
<td>Customer Power</td>
<td>Debtor Risk/Accounts Receivable Risk</td>
</tr>
<tr>
<td>Diversification of Products</td>
<td>Owner's Support</td>
</tr>
<tr>
<td>Competitive Position</td>
<td>Intrinsic Full Value of Intangibles</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Company</td>
<td>Management</td>
</tr>
<tr>
<td>Years in Relationship</td>
<td>Experience in Industry</td>
</tr>
<tr>
<td>Business Stage</td>
<td>Financial Reporting and Formal Planning</td>
</tr>
<tr>
<td>Supplier Power</td>
<td>Risk Management</td>
</tr>
<tr>
<td>Credit History</td>
<td>Openness</td>
</tr>
<tr>
<td>Conduct of Account</td>
<td>Risk Appetite</td>
</tr>
<tr>
<td>Quality Management</td>
<td>Management Style &amp; Structure</td>
</tr>
</tbody>
</table>
Normalizing Qualitative Information Gives a More Universal Interpretation to the Qualitative Score

Qualitative information is typically captured as answers to a series of questions. 

Answers are assigned numbers and a weighted combination of answers forms the qualitative score. 

The relative importance of the different questions are based on expert judgment. 

It is convenient to convert the qualitative information to a “standardized score”:

$$z_Q = \frac{Q - \text{mean}(Q)}{\text{stdev}(Q)}$$
After financial statements are spread the analyst completes the judgmental sections:

- Balance Sheet Factors
- Industry / Market conditions
- Company profile
- Quality of Management
## Internal Rating Model - RiskCalc Scorecard

<table>
<thead>
<tr>
<th>Category</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audit Method</td>
<td>Projection</td>
</tr>
<tr>
<td>Inventory Valuation</td>
<td>Owner's Estimates</td>
</tr>
<tr>
<td>Debtor Risk / Accounts Receivable Risk</td>
<td>Good spread / Good Quality</td>
</tr>
<tr>
<td>Owner's Support</td>
<td>&lt; 10%</td>
</tr>
<tr>
<td>Intrinsic Full Value of Intangibles</td>
<td>Negligible</td>
</tr>
</tbody>
</table>

### Owner's Support

Owner’s Support refers to the level of additional financial support that the owners are able to provide to the business. This support may provide a cushion against bankruptcy in times of adversity and may therefore reduce the likelihood of a default.

In order to derive a figure for potential support, consider the assets controlled by the owners together with any other income that they receive. Are the owners likely to be able (and willing) to raise cash from assets and to use this to support the business? Take into account any liens that may restrict sale or the use of these assets to support the business prior to default. Also, if the assets belong to the owners but are used in the operations of the business, consideration should be given to the viability of the business if such assets were sold. In addition, is there any external income that the owners may have? Consider whether the owners are likely to divert this to support the business in times of trouble.

Then consider your estimate of the available support as a percentage of existing and proposed facilities.
### Internal Rating Model - RiskCalc Scorecard

<table>
<thead>
<tr>
<th>RiskCalc EDF</th>
<th>Balance Sheet Factors</th>
<th>Industry / Market</th>
<th>Company</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Audit Method
- Projection

#### Inventory Valuation
- Owner's Estimates

#### Debtor Risk / Accounts Receivable Risk
- Good spread / Good Quality

#### Owner's Support
- < 10%

#### Intrinsic Full Value of Intangibles
- Negligible

### Final score for the Balance Sheet Factors

<table>
<thead>
<tr>
<th>Factor</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audit Method</td>
<td>33%</td>
</tr>
<tr>
<td>Inventory Valuation</td>
<td>16%</td>
</tr>
<tr>
<td>Debtor Risk / Accounts Receivable Risk</td>
<td>18%</td>
</tr>
<tr>
<td>Owner's Support</td>
<td>22%</td>
</tr>
<tr>
<td>Intrinsic Full Value of Intangibles</td>
<td>11%</td>
</tr>
</tbody>
</table>
Final score for the Industry / Market assessment

0% Industry ... Industry risk is reflected in the RiskCalc EDF values
36% Market Conditions
36% Customer Power
17% Diversification of Products
11% Competitive Position
### Internal Rating Model - RiskCalc Scorecard

<table>
<thead>
<tr>
<th>Factor</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years in Relationship</td>
<td>&gt;2 Years</td>
</tr>
<tr>
<td>Business Stage</td>
<td>Stable-Mature</td>
</tr>
<tr>
<td>Quality Management</td>
<td>Meets Industry Standards</td>
</tr>
<tr>
<td>Supplier Power</td>
<td>Significant</td>
</tr>
<tr>
<td>Credit History</td>
<td>Clear</td>
</tr>
<tr>
<td>Conduct of Account</td>
<td>Minor Breaches</td>
</tr>
</tbody>
</table>

**Company Score:**

- **0.00**
- **59.89**
- **99.97**

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**Final score for the Company assessment**

- **10%** Years in Relationship
- **14%** Business Stage
- **10%** Quality Management
- **20%** Supplier Power
- **23%** Credit History
- **23%** Conduct of Account

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Moody's Analytics

Combining Quantitative and Qualitative Approaches
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- Balance Sheet Factors: 3.73
- Industry / Market: 3.74
- Company: 21.56
- Management: 11.03
- Total Qualitative: 40.05

RiskCalc EDF: 3.14%

Projection: 2007 stress test proj
Grade: Ba3
FSO/CCA: FSO
1 Yr/5 Yr: 1 Yr
RiskCalc model: RiskCalc for Private Firm (United States) 3.1
Statement Date: 12/31/2007

Total: Percentile 76.00% Grade B1 Equivalent PD 2.7463%

Override Reason: 
Grade: 
Override PD:

Authorized By: Marc Brammer

Facilities Total

<table>
<thead>
<tr>
<th>Committed</th>
<th>Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>EAD</td>
<td>LGD %</td>
</tr>
<tr>
<td>5577.00</td>
<td>36.90 %</td>
</tr>
<tr>
<td>5577.00</td>
<td>45.00 %</td>
</tr>
</tbody>
</table>
3. Weighting the two Approaches to Maximize Accuracy
The model produces a PD estimate based exclusively on historical and projected financial statements ...
Combining Quantitative and Qualitative Approaches

19% weight for Balance Sheet Factors
18% weight for Industry / Market
36% weight for Company
27% weight for Management

Projection: 2007 stress test proj
RiskCalc EDF: 3.14%
Grade: Ba3

FSO/CCA: FSO
1 Yr/5 Yr: 1 Yr
RiskCalc model: RiskCalc for Private Firm (United States) 3.1
Statement Date: 12/31/2007

Total Qualitative

Percentile: 76.00%
Grade: B1
Equivalent PD: 2.7463%

Authorized By: Marc Brammer

Facilities Total
EAD | LGD % | Facility Grade | EL % | EL Grade
---|---|---|---|---
Committed
5577.00 | 36.90 % | C.dem | 1.16 % | A.dem
Proposed
5577.00 | 45.00 % | E.dem | 1.41 % | A.dem
Combining Quantitative and Qualitative Approaches

35% weight + 65% weight = Borrower rating and PD

Ratings Summary

Projection: 2007 stress test proj
RiskCalc EDF

Balance Sheet Factors
Industry / Market
Company
Management
Total Qualitative

Total

Percentile 76.00 % Grade B1

Equivalent PD 2.7463 %

Facilities Total

Committed
Proposed

EAD LGD % Facility Grade EL % EL Grade
5577.00 36.90 % C.dem 1.16 % A.dem
5577.00 45.00 % E.dem 1.41 % A.dem

Moody's Analytics
How to set appropriate weights for the 2 Approaches

In God We Trust…. All Others Will Have To Bring Data!

<table>
<thead>
<tr>
<th></th>
<th>Firms</th>
<th>Statements</th>
<th>Defaults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low 3</td>
<td>7907</td>
<td>22916</td>
<td>536</td>
</tr>
<tr>
<td>Mid 5</td>
<td>18822</td>
<td>49402</td>
<td>407</td>
</tr>
<tr>
<td>Top 3</td>
<td>53338</td>
<td>160211</td>
<td>2835</td>
</tr>
<tr>
<td>Total</td>
<td>80067</td>
<td>232529</td>
<td>3778</td>
</tr>
</tbody>
</table>

Data from 11 US banks from 2002 to 2009 grouped according to number of statements.
A weight of 65% on the EDF yields a higher accuracy ratio than either the internal rating or the RiskCalc EDF.

The combined score is computed as:

$$Score = \left( wz_{EDF} + (1-w)\tilde{z}_Q \right) \left( w^2 + (1-w)^2 \right)^{-1/2}$$

Presents the quartiles of ARs across the 11 banks.

Dashed lines represent the AR of the internal ratings of the 11 banks.
Conclusion

A quantitative approach to credit risk provides a sound foundation for assessing credit risk

- Efficient
- Consistent
- Objective
- Testable

The qualitative factors that credit analysts look at can potentially add value.

The combination of the two approaches appears to be stronger than either approach on its own.

RiskCalc can be used in combination with subjective factors through the RiskCalc Scorecard.
Combining Quantitative and Qualitative Approaches