Credit and Counterparty Risk Modeling

An Industry Perspective

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CRISIL GR&A Summary

Global Leader in Research & Analytics Space
- Track record of 25 years
- Pioneered Global Research & Analytics
- Team of more than 2,300 analysts
- Serve 12 of the top 15 global investment banks
- Serve 2 of the top 10 global consulting groups
- Serve 3 of the top 15 global insurance companies
- Regulated by SEBI, an SEC-equivalent
- The only regulated entity in this space
- Highest standards of regulatory, compliance, and confidentiality

Regulated Entity with Strong Compliance Culture
- Recognized for high quality service – Our tagline “The best people to work with” is a verbatim reproduction of what a client said in a survey
- Highly experienced & stable management team to ensure high-touch engagement
- Large talent pool comprising MBAs/CAs/CFA/FRMs/PhDs and other university graduates

High Quality Skill Sets
- Strong project management capabilities
- Quality Assurance and Governance
- Information Security
- Robust training programmes
- Business Continuity
- Inbuilt processes and tools to enhance productivity

Rigorous & Scalable Processes
- Well-diversified business
- Strong balance sheet and zero debt
- Market reputation and global reach
- 30% CAGR over past 10 years
- Consistent growth across business cycles that provides stability to deliver high quality services to our clients

Unmatched Financial Business Strength

Partnerships with Expert Networks
- CRISIL GR&A joined the FINCAD Alliance Program in order to leverage various FINCAD Analytics tool that meets the derivatives and fixed income needs of clients. FINCAD is the market leader for innovative derivatives solutions.

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Agenda

- **Credit Risk Modeling**
  - Regulatory Landscape Governing Credit Risk
  - Credit Risk Estimation
    - IRB Approach
    - Computation of PD, LGD, and EAD under IRB
    - Low Default Portfolios

- **Counterparty Risk Modeling**
  - Regulatory Landscape Governing Counterparty Risk
  - Counterparty Risk Estimation
    - Exposure Modeling
    - Credit Value Adjustment

- **Governance Framework for Internal Modeling**
  - Validation of Internal Model Rating System
  - Model Validation of Credit Risk Models
Important regulatory considerations

- Probabilities of default (PDs) need to be computed with appropriate levels of conservatism. They should be forward-looking and meant for the long run.
- Estimates need to be grounded in historical experience and empirical evidence, and should not be based purely on subjective or judgmental considerations
- The margin of conservatism should be in proportion to the likely range of errors
- The IRB approach needs to be well integrated with the lending processes

Moving from the Standardized to IRB approach requires considerable focus

<table>
<thead>
<tr>
<th>Standardized</th>
<th>Regulators determine the risk weights, external ratings used</th>
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<tbody>
<tr>
<td>Foundation - IRB</td>
<td>Robust internal ratings process needs to be created to compute PD</td>
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<tr>
<td>Advanced - IRB</td>
<td>Need to model PD, LGD (Loss Given Default) and Exposure at Default (EAD). Significant investment in setting up modeling, model validation, ratings processes and IT</td>
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Credit Risk Estimation – IRB Approach

- Of late, the industry has been focused on setting up a robust internal ratings process; realistic estimation of loss given default (LGD); and frequent computation of exposure at default (EAD)
- A key challenge has been to satisfactorily compute PDs based on expert rank-based rating processes, typically used for large corporate counterparties (SME, large) and specialized lending

Various credit modeling techniques used to compute PD, LGD, and EAD

**Probability of Default**
- **Statistical**: macro- and obligor-specific data
- **Pooling**: historical default data of a large universe of obligors
- **Structural**: based on its assets and liabilities
- **Expert Ranking**: hybrid approach, expert scoring, and probabilistic calibration

**Loss Given Default**
- **Market LGD**: market prices of defaulted bonds/loans
- **Workout LGD**: cash flows from workout process
- **Implied LGD**: market prices of non-defaulted bonds/loans
- **Statistical LGD**: regression on historical LGDs and facility characteristics

**Exposure At Default**
- **Credit Conversion Factor**: used to estimate the EAD for lines of credit and off-balance sheet
  - Two methods of computing the Credit Conversion factor:
    - Cohort Method
    - Fixed Horizon Method
IRB Approach – Computing PD

- Statistical and pooling approaches are suited for retail loan portfolios, while structural and expert-based approaches are used in commercial loan portfolios. The structural approach finds favor with regulators because the computed PDs are dynamic and market-linked.
- Pure expert-based models could be relevant for certain segments of the commercial portfolio (insurance companies, non-profit organizations)

Suggested approach to ensure accurate internal modeling process for computing PDs

- **Defining**
  - Segment of interest
  - Analysis of portfolio, processes, IT systems
  - Establishment of the working team

- **Data Collection and Cleaning**
  - Identification and collection of data
  - Cleaning and arranging data

- **Data Analysis**
  - Single & multi-factor analysis
  - Identification of the final set of variables

- **Model Development**
  - Development of model that produces default scores
  - Goodness-of-fit checks

- **Model Calibration**
  - Mapping model output scores to PDs
  - Employing PIT/ TTC/Hybrid approaches to calibration

- **Embedding the Model**
  - Model release
  - Integration of statistical and expert processes
  - Banking processes and IT systems
IRB Approach – Computing LGD and EAD

- Banks use market or implied approach to estimate LGDs of liquid and traded instruments; workout LGD can be used for instruments that are illiquid/have no market
- EAD is typically computed through two methods endorsed by regulators – Cohort Method & Fixed Horizon Method
- These two methods consider information only at a point in time; information on exposure evolution prior to default can be valuable

Techniques used to estimate LGD and their comparison

<table>
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<tr>
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<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td><strong>Workout LGD</strong></td>
<td>- More precise estimate of LGD</td>
<td>- Computationally intensive</td>
</tr>
<tr>
<td></td>
<td>- Bank’s internal data used</td>
<td>- Cost of calculation is high</td>
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<tr>
<td><strong>Market LGD</strong></td>
<td>- Less computationally intensive</td>
<td>- Asset coverage is low</td>
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<td></td>
<td>- Works well for liquid market instruments</td>
<td>- Lack of precision</td>
</tr>
<tr>
<td><strong>Implied LGD</strong></td>
<td>- Less computationally intensive</td>
<td>- Bonds’ representation of internal exposure not known</td>
</tr>
<tr>
<td></td>
<td>- Works well for liquid market instruments</td>
<td>- Lack of liquidity will affect the results</td>
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Dealing with Low Default Portfolios

- Regulators are concerned on the usage of simple historical default averages for low default portfolios as it may underestimate capital requirements.
- An appropriate low-default calibration approach can help in alleviating regulatory concerns.
- Highly conservative models often don’t find acceptance among banks because of the high regulatory capital required.
- A combination of various calibration can be used in the ‘benchmarking’ process.

Many approaches are currently being considered in the industry for handling LDPs, some of which are:

- **Pluto-Tasche**: Assumes uncorrelated events, most prudent estimation principle.
- **Forest Approach**: Log-likelihood method and binomial model for observed default data.
- **Frunza Approach**: Resampling/Bootstrap method which does not require an analytical framework.
- **Dwyer Approach**: Single-factor method used to model the distribution of defaults.

A limitation of the above calibration approaches is that they do not take into account the point-in-time or through-the-cycle perspectives of PD.
Counterparty risk is associated with OTC Derivatives transactions and security financing transactions (SFT).

Counterparty risk differs from other forms of credit risk, due to challenges in modeling the credit risk exposure and pricing this risk into the transactions (Credit Value Adjustments).

Evolution of Basel Regulations concerning counterparty credit risk (CCR)

- **Basel II**: Assumed counterparty trades held till maturity; dealt with CCR only from the credit risk angle.
- **BASEL 2.5**: Looked at the credit risk of instruments in the trading book.
- **Basel III**
  - Introduced CVA in the calculation of CCR capital charge.
  - Assumes banks have to actively manage and hedge CCR.
  - Takes into account both credit risk (default risk) and market risk (credit migration risk) elements in CCR.

- **Dodd Frank**: Emphasized moving OTC Derivatives transactions to central counterparties.
Counterparty Risk Estimation – Exposure Modeling

- Exposure modeling requires integrated approach and needs to be in sync with trading systems
- Most banks perform daily exposure monitoring; very few do on an intra-day basis
- Increased focus on collateral management/modeling by banks

Exposure Modeling: To value the portfolio at a future date (does not include default risk by counterparty), the simulation VaR modeling approach is followed

A bank may use any one of the following approaches to model OTC exposures:

**Current Exposure Method**
- Current Exposure + PFE
- PFE calculated by multiplying notional values with fixed CCFs, depending on the asset class
- Collateral and netting performed on EAD

**Standardized Method**
- More risk-sensitive than CEM
- Absolute value of the net risk positions in the hedging sets considered
- Includes an extra reserve for potential downturns

**Internal Model Method**
- The most risk-sensitive approach; require approval from the local market regulator
- Effective Expected Positive Exposure used to calculate exposure
- Monte Carlo simulation VaR employed to model expected EPE
Counterparty Risk Estimation – Credit Value Adjustment

Multiple business challenges that the industry is grappling with in managing CVA include:

- Computational intensity/time
- Real-time manual monitoring
- Illiquid CDS market
- Multiple calculation engines
- Decentralized hedging

1. CVA: The difference between risk-free portfolio value and true portfolio value
2. CVA has a market risk viewpoint, similar to the spread of a bond being treated as market risk
3. Right-way and wrong-way risks manifested through CVA affects counterparty credit risk
4. CVA calculation should account for correlations among market variables, default probabilities and recovery values, netting, collateral agreements, and wrong-way risk
Governance Mechanism for Internal Modeling

- Compliance with regulatory guidance requires setting up robust processes to ensure validation of models and rating processes, creating proper documentation, and ensuring appropriate IT systems.

- Model validation needs to be done at the initial stage as well as periodically.

- Regulators also look at how well the models are integrated with the banking processes set up, and closely review the internal rating process.

### Internal Model Rating System

- Robust, well documented Model methodology
- Review PD, LGD, EAD computations

### Validation of Banking Processes

- Robust, well documented, credit ratings process
- Test IT Systems
- Check data quality
Model Validation of Credit Risk Models

- Data issues could lead to incorrect models due to random missing defaults, false defaults, misclassification errors, errors in independent variable data while development
- Emphasis needs to be on thorough analysis/testing of model assumptions and limitations and back testing
- Independent tests need to be performed on model discriminatory power, model performance, and the fit of the model
- Less data will impact back testing in the model validation process; bootstrapping method can be used

CRISIL GR&A’s recommended process for model validation

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<th>Scope &amp; Data Validation</th>
<th>Model Theory</th>
<th>Model Usage</th>
<th>Backtesting &amp; Benchmarking</th>
<th>Analysis &amp; Re-validation</th>
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<td>Methodology theory</td>
<td>Implementation</td>
<td>Exception/accuracy</td>
<td>Sensitivity testing</td>
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<tr>
<td>Source verification</td>
<td>Model assumptions</td>
<td>Independent testing</td>
<td>Stress/benign period</td>
<td>Weakness/limitations</td>
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<tr>
<td>Data quality</td>
<td>Model limitations</td>
<td>Portfolio testing</td>
<td>Third-party tools</td>
<td>Model documentation</td>
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<td>Data remediation</td>
<td></td>
<td>Code review</td>
<td>Other techniques</td>
<td>Assumption limitation</td>
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<td></td>
<td></td>
<td>Model variations</td>
<td></td>
<td>Model re-validation</td>
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