IFRS 9 Scenario Implementation and ECL Calculation for Retail Portfolios

Alaistair Chan, Economist | Olga Loiseau-Aslanidi, Senior Economist and Risk Modeler
Moody's Analytics operates independently of the credit ratings activities of Moody's Investors Service. We do not comment on credit ratings or potential rating changes, and no opinion or analysis you hear during this presentation can be assumed to reflect those of the ratings agency.
Speakers

Alaistair Chan
ECONOMIST
Covers national and metropolitan economic issues across the Asia-Pacific region.

Olga Loiseau-Aslanidi
SENIOR ECONOMIST & RISK MODELER
Designs and implements models for stress-testing and forecasting.
Agenda

1. Economic Scenarios in a Probability Weighted Environment
2. Global Macroeconomic Forecasting Models
3. Retail Credit Methodology Challenges
1 Economic Scenarios in a Probability-Weighted Environment
Addressing IFRS 9 Forward-Looking Aspects

“An entity shall measure ECL of a financial instrument in a way that reflects an unbiased and probability-weighted amount that is determined by evaluating a range of possible outcomes.” (5.5.17)

“When measuring ECL, an entity need not necessarily identify every possible scenario. However, it shall consider the risk of probability that a credit loss occurs by reflecting the possibility that a credit loss occurs and the possibility that no credit loss occurs, even if the possibility of a credit loss occurring is very low.” (5.5.18)

“This may not need to be complex analysis. In some cases, relatively simple modelling may be sufficient, without the need for a large number of detailed simulations of scenarios.” (B5.5.42)

“…an entity need not necessarily identify every possible scenario.” (5.5.18)
Key Take-Aways

**Forward Looking & Probability-Weighted Outcomes**

» Requires expected credit losses (ECL) to account for forward-looking information

» Requires probability-weighted outcomes when measuring expected credit losses
  – Estimates should reflect the possibility that a credit loss occurs and the possibility that no credit loss occurs

*Macroeconomic modelling satisfies both requirements above*
ECL Calculations – Lifetime Example

Example with 3 Scenarios (s1, s2, s3) & (1, 2,…, t') Periods
Forward Looking Probability Weights

On the Number of Scenarios and Probability Targets

Q9 cumulative loss

Loss ($bn)

0 50000 100000 150000 200000 250000

Q9 cumulative loss

Loss ($bn)

0 0.2 0.4 0.6 0.8 1.0

MOODY’S ANALYTICS

IFRS 9 Scenario and Retail Portfolio Strategy, October 24th, 2017
Global Macroeconomic Forecasting Models
Macroeconomic Forecasts
Mix of Theory and Data

**Theory**
- Quality of forecast and scenarios
- Complex
- Limited quantity of forecasts

**Data**
- Quality and quantity of forecasts
- Easy to produce
- Not ideal for scenario analysis

**Our Models**
Intersection of purely data- and purely theory-based Models
Structural Forecast Model Methodology
With Detailed Quantitative & Qualitative Testing

Specification choice
» Theoretical reasoning versus statistical properties

In-sample equation fit
» R-squared, RMSE, information criteria
» Fitted values and residuals

Forecasting performance
» Back-testing: conditional and unconditional evaluation
» Benchmarking during important past episodes

Sensitivity to shocks
» Forecasts across scenarios
» Response to individual shocks
Comprehensive Coverage
More Than 1,800 Forecast Variables for 60+ Countries

Core economic concepts:

» National Accounts
» Balance of Payments
» Government Finance
» Industrial Production
» Producer Price Index
» Retail Sale Index

» Interest Rates
» Stock Markets
» Money Markets
» Labor
» Home Price Indices
» and many more…
Moody’s Analytics Scenarios
Reasonable and Defensible Forecasts from Moody’s Analytics

Key Features
» 30-year horizon, for baseline forecast plus up to eight alternative scenarios
» Coverage of more than 1,800 economic, financial and demographic variables
» Available for 60+ countries globally
» Forecasts updated monthly, history updated in real-time
» Fully documented model methodology; scenario assumptions published monthly
» Model validation reports available
Moody’s Analytics Scenarios

Custom Built (e.g. ICAAP) Event-Driven

Alternative Economic Scenarios

Baseline

S1: Stronger Near-Term Growth
1-in-10

S2: Mild Recession
1-in-4

S3: Deep Recession
1-in-10

S4: Protracted Slump
1-in-25

Sovereign Default Shock

Emerging Markets Hard Landing

In line with Regulatory Guidelines

Forecast

1:100

1:25

1:20

1:10

1:4

Forecast

1:10

Weaker Economy

Simulation-Based

Healthier Economy
From Severity to Probability of Occurrence

How Do we Gauge Severity and Probability of a Particular Scenario?

Severity: Probability that particular economic statistic is less than in a given scenario -> IFRS 9

Different metrics:

» Real GDP growth over a period
» Real GDP start-to-trough
» Unemployment rate start-to-trough

Historical analysis:

» Compute historical mean and standard deviations of variables of interest; e.g. GDP growth rate
» Compare scenarios in terms of standard deviation
» Assume normality to estimate probabilities
» Drawback: history only one realization of the stochastic process; not many periods to compare
Shocks and Scenarios

Points of Calibration
» Severity (e.g. peak to trough of real GDP, peak unemployment rate)
» Probability (where does severity fall in distribution of outcomes?)

Methods of Calibration
» Historical analysis: empirical distribution of a given metric
  – Example: a histogram of the unemployment rate, or real GDP growth rates
  – Drawbacks: Limited data samples, reflects an unconditional distribution

» Monte Carlo simulation
  – Estimate a stochastic model (e.g. VAR of growth, inflation and interest rates)
  – Simulate forecast paths and compute distribution of 5-year growth rates.
  – Assign probabilities based on the distribution of simulated paths

» IFRS 9 – convert continuous CDF probabilities to discrete PDFs.
  – 10th percentile – low stress
  – 50th percentile – baseline
  – 90th percentile – high upside
Scenario Calibration: Discrete Scenario Prob.

GDP Growth %, Annualized avg, 10,000 Simulations over a 5-yr Period

Source: Moody's Analytics

S3: 30% discrete prob = 10% (s3 CDF) + 20% (1/2 distance s3-bl)

S3: 10% CDF downside

BL: 40% discrete prob

BL: 50% CDF baseline

S1: 30% discrete prob = 10% (s1 CDF) + 20% (1/2 distance s1-bl)

S1: 10% CDF upside
Australia, Scenario Forecasts

Unemployment rate, %

Sources: Australia Bureau of Statistics, Moody's Analytics
China, Scenario Forecasts

GDP, % change yr ago

Sources: National Bureau of Statistics, Moody’s Analytics
Thailand, Scenario Forecasts

Exports, 2002 THB bil, SAAR

Sources: National Bureau of Statistics, Moody’s Analytics
Web Based Interface, Office Add-In, or API
View, Manipulate and Automate Delivery of Data in a Variety of Formats
Retail Credit Methodology Challenges
Retail Credit Methodology Challenges
Ensuring Consistency with Stress Testing, ICAAP & Pricing Models

- **PD Models**
  - PIT PD
  - Lifetime PD/PD Term Structure

- **LGD Models**
  - PIT LGD
  - Lifetime LGD/LGD Term Structure
  - Discounting (EIR)

- **EAD Models**
  - Lifetime EAD/EAD Term Structure
  - Discounting
  - Prepayment

- **Transferring Criteria**
  - Threshold Definition
  - Intra-stage Movements
Retail Credit Methodology Challenges
Ensuring Consistency with Stress Testing, ICAAP & Pricing Models

» Dynamic panel data models, cluster-based combined with vintage/cohort analysis
  – Well suited to capture lifecycle aspect of credit behavior and bring macroeconomic factors explicitly

» Alternative methods can be tested for default rates or losses, such as
  – Roll-rate/transition approaches
  – Loan or obligor-level logistic regression models
  – Survival analysis models, or simpler top-down time-series models
Retail Credit Methodology Challenges
Ensuring Consistency with Stress Testing, ICAAP & Pricing Models

» Historical data used to build the econometric equations
  – Optimal variable search methods leveraged to select the macroeconomic “best drivers” into the model

» Historical data integrity is imperative, and the main dependency
  – Granularity, frequency, consistency, completeness, and quality
  – Limitations can put constraints on the type of modelling techniques that can be utilized
Retail Credit Methodology Challenges
Ensuring Consistency with Stress Testing, ICAAP & Pricing Models

» Selected macroeconomic variables tested to bring the forward-looking dimension
  – PDs and secured LGDs explicitly connected to macro data
  – EAD and unsecured LGDs often modelled independently of economic factors

» Explicit, closed-form equations, ensuring 100% transparency in our approach

» Detailed model documentation and validation

» Feedback from validation team & auditors incorporated

» Model governance, re-calibration updates, monitoring, use test
Leading Example: Vintage Panel-Data Structure

Hypothetical Data (over age)

Lifecycle Effect (over age)

Vintage Quality (over age)

Business Cycle Effect (over time)
Leading Example: Vintage Panel-Data Structure

(1) Lifecycle component
- Dynamic evolution of vintages as they mature
- Nonlinear model against "age"

(2) Vintage-quality component
- Vintage attributes (LTV, asset class/collateral type, geography, etc.) define heterogeneity across cohorts
- Early arrears serve as proxies for underlying vintage quality
- Economic conditions at origination matter
- Econometric technique accounts for time-constant, unobserved effect

(3) Business cycle exposure component
- Sensitivity of performance to the evolution of macroeconomic and credit series

Time series performance for a given vintage of loans $= f$
## Macroeconomics of Credit Risk: Data Input

Examples of Economic and Internal Drivers

<table>
<thead>
<tr>
<th>Economic Data  (Macro &amp; Regional)</th>
<th>Portfolio Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>» Labour Market Indicators</td>
<td>» Observed Performance</td>
</tr>
<tr>
<td>Employment, Unemployment, Wage/Salary Growth</td>
<td>Delinquencies, Defaults, Losses, Prepayments</td>
</tr>
<tr>
<td>» Housing Market Indicators</td>
<td>» Credit Score Cut-offs</td>
</tr>
<tr>
<td>Home Prices, Home Sales, Housing Starts, Permits</td>
<td>» Credit Applications</td>
</tr>
<tr>
<td>» Financial Market Indicators</td>
<td>» LTVs</td>
</tr>
<tr>
<td>Policy Rate, Debt-Service Ratios, Revolving Consumer Debt</td>
<td>» Payment-to-Income</td>
</tr>
<tr>
<td>» Economic Performance</td>
<td>» Marketing Activity</td>
</tr>
<tr>
<td>GDP Growth, Disposable Income Growth</td>
<td>» Collection Treatments</td>
</tr>
<tr>
<td>» Industry/Sector Drivers</td>
<td></td>
</tr>
<tr>
<td>Sales, Employment, Pricing</td>
<td></td>
</tr>
</tbody>
</table>

### Economic Data

- **Labour Market Indicators**
  - Employment, Unemployment, Wage/Salary Growth

- **Housing Market Indicators**
  - Home Prices, Home Sales, Housing Starts, Permits

- **Financial Market Indicators**
  - Policy Rate, Debt-Service Ratios, Revolving Consumer Debt

- **Economic Performance**
  - GDP Growth, Disposable Income Growth

- **Industry/Sector Drivers**
  - Sales, Employment, Pricing
Credit Risk Model Building Example

Variable Selection Algorithm

$C^k_m$: right-hand-side variables
$C^m_m$: potential economic & internal drivers

All combinations of size $k$ from vector $m$

**Pairwise Correlations** (optional)
Exclude models with collinear drivers

**Selection Criteria** (optional)
- Expected estimated signs on drivers
- Statistically significant drivers

**Ranking Criteria**
- Adjusted $R^2$/RMSE
- Likelihood-based criteria
- Stationarity and cointegration
- Validation

**Optimal Model**
Scenario-based Projections Example
Marginal Default Rate (MDR), Vintage Model Outputs

Sources: Moody’s Analytics
Scenario-based Projections Example

1-Yr PD (Jul-15 vintage example), Aggregating MDR

Sources: Moody’s Analytics
Scenario-based Projections Example

Lifetime PD (Jul-15 vintage example), Aggregating MDR

Sources: Moody’s Analytics
ECL Calculation Example

Current Reporting Date, Stage 2 Accounts

1) Calculate ECL for each account i, time t, portfolio j, and scenario s

\[ ECL(i, j, t|s) = PD(i, j, t|s) \times LGD(i, j, t|s) \times EAD(i, j, t|s) \times DF(i, j, t|s) \]

2) Sum ECL across the lifetime (or 1 year for stage 1 accounts)

\[ ECL(i, j|s) = \sum_t ECL(i, j, t|s) \]

3) Compute scenario-weighted expected ECL using associated probabilities

\[ ECL(i, j) = p_1ECL(i, j|s_1) + p_2ECL(i, j|s_2) + \ldots + p_SECL(i, j|s_S) \]

4) Sum across accounts to get overall portfolio-level ECL

\[ ECL(j) = \sum_i ECL(i, j) \]
IFRS 9 Model Validation

Credit institution should have policies and procedures to appropriately validate models used to calculate ECL.

**Quantitative Validation**
- Macro models used to generate scenarios
- Credit risk models for PD, LGD, EAD
- Staging criteria
- Scenario probabilities
- Lifetime ECL

**Qualitative Validation**
- Theoretical model assumptions
- Econometric techniques
- Documentation quality
- Data quality
- Regulatory requirements compliance
Q&A

Have a question or need more information? Get in touch with our client service team by email at help@economy.com or contacts us at a location below
© 2017 Moody’s Corporation, Moody's Investors Service, Inc., Moody’s Analytics, Inc. and/or their licensors and affiliates (collectively, “MOODY’S”). All rights reserved.

CREDIT RATINGS ISSUED BY MOODY'S INVESTORS SERVICE, INC. AND ITS RATINGS AFFILIATES (“MIS”) ARE MOODY’S CURRENT OPINIONS OF THE RELATIVE FUTURE CREDIT RISK OF ENTITIES, CREDIT COMMITMENTS, OR DEBT OR DEBT-LIKE SECURITIES, AND MOODY’S PUBLICATIONS MAY INCLUDE MOODY’S CURRENT OPINIONS OF THE RELATIVE FUTURE CREDIT RISK OF ENTITIES, CREDIT COMMITMENTS, OR DEBT OR DEBT-LIKE SECURITIES. MOODY’S DEFINES CREDIT RISK AS THE RISK THAT AN ENTITY MAY NOT MEET ITS CONTRACTUAL, FINANCIAL OBLIGATIONS AS THEY COME DUE AND ANY ESTIMATED FINANCIAL LOSS IN THE EVENT OF DEFAULT. CREDIT RATINGS DO NOT ADDRESS ANY OTHER RISK, INCLUDING BUT NOT LIMITED TO: LIQUIDITY RISK, MARKET VALUE RISK, OR PRICE VOLATILITY. CREDIT RATINGS AND MOODY’S OPINIONS INCLUDED IN MOODY’S PUBLICATIONS ARE NOT STATEMENTS OF CURRENT OR HISTORICAL FACT. MOODY’S PUBLICATIONS MAY ALSO INCLUDE QUANTITATIVE MODEL-BASED ESTIMATES OF CREDIT RISK AND RELATED OPINIONS OR COMMENTARY PUBLISHED BY MOODY’S ANALYTICS, INC. CREDIT RATINGS AND MOODY’S PUBLICATIONS DO NOT CONSTITUTE OR PROVIDE INVESTMENT OR FINANCIAL ADVICE, AND CREDIT RATINGS AND MOODY’S PUBLICATIONS ARE NOT AND DO NOT PROVIDE RECOMMENDATIONS TO PURCHASE, SELL, OR HOLD PARTICULAR SECURITIES. NEITHER CREDIT RATINGS NOR MOODY’S PUBLICATIONS COMMENT ON THE SUITABILITY OF AN INVESTMENT FOR ANY PARTICULAR INVESTOR. MOODY’S ISSUES ITS CREDIT RATINGS AND PUBLISHES MOODY’S PUBLICATIONS WITH THE EXPECTATION AND UNDERSTANDING THAT EACH INVESTOR WILL, WITH DUE CARE, MAKE ITS OWN STUDY AND EVALUATION OF EACH SECURITY THAT IS UNDER CONSIDERATION FOR PURCHASE, HOLDING, OR SALE.

MOODY’S CREDIT RATINGS AND MOODY’S PUBLICATIONS ARE NOT INTENDED FOR USE BY RETAIL INVESTORS AND IT WOULD BE RECKLESS AND INAPPROPRIATE FOR RETAIL INVESTORS TO USE MOODY’S CREDIT RATINGS OR MOODY’S PUBLICATIONS WHEN MAKING AN INVESTMENT DECISION. IF IN DOUBT YOU SHOULD CONTACT YOUR FINANCIAL OR OTHER PROFESSIONAL ADVISER.

ALL INFORMATION CONTAINED HEREIN IS PROTECTED BY LAW, INCLUDING BUT NOT LIMITED TO, COPYRIGHT LAW, AND NONE OF SUCH INFORMATION MAY BE Copied OR OTHERWISE REPRODUCED, REPAKAGED, FURTHER TRANSMITTED, TRANSFERRED, DISSEMINATED, REDISTRIBUTED OR RESOLD, OR STORED FOR SUBSEQUENT USE FOR ANY SUCH PURPOSE, IN WHOLE OR IN PART, IN ANY FORM OR MANNER OR BY ANY MEANS WHATSOEVER, BY ANY PERSON WITHOUT MOODY’S PRIOR WRITTEN CONSENT.

Any information contained herein is obtained by MOODY’S from sources believed by it to be accurate and reliable. Because of the possibility of human or mechanical error as well as other factors, however, all information contained herein is provided “AS IS” without warranty of any kind. MOODY’S adopts all necessary measures so that the information it uses in assigning a credit rating is of sufficient quality and from sources MOODY’S considers to be reliable including, when appropriate, independent third-party sources. However, MOODY’S is not an auditor and cannot in every instance independently verify or validate information received in the rating process or in preparing the Moody’s publications.

To the extent permitted by law, MOODY’S and its directors, officers, employees, agents, representatives, licensors and suppliers disclaim liability for any direct or compensatory losses or damages caused to any person or entity, including but not limited to by any negligence (but excluding fraud, willful misconduct or any other type of liability that, for the avoidance of doubt, by law cannot be excluded) on the part of, or any contingency within or beyond the control of, MOODY’S or any of its directors, officers, employees, agents, representatives, licensors or suppliers, arising from or in connection with the information contained herein or the use or inability to use any such information.

NO WARRANTY, EXPRESS OR IMPLIED, AS TO THE ACCURACY, TIMELINESS, COMPLETENESS, MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OF ANY SUCH RATING OR OTHER OPINION OR INFORMATION IS GIVEN OR MADE BY MOODY’S IN ANY FORM OR MANNER WHATSOEVER.

Moody’s Investors Service, Inc., a wholly-owned credit rating agency subsidiary of Moody’s Corporation (“MCO”), hereby discloses that most issuers of debt securities (including corporate and municipal bonds, debentures, notes and commercial paper) and preferred stock rated by Moody’s Investors Service, Inc. have, prior to assignment of any rating, agreed to pay to Moody’s Investors Service, Inc. for appraisal and rating services rendered by it fees ranging from $1,500 to approximately $2,500,000. MCO and MIS also maintain policies and procedures to address the independence of MIS’s ratings and rating processes. Information regarding certain affiliations that may exist between directors of MCO and rated entities, and between entities and Moody’s Investors Service, Inc. have also publicly reported to the SEC an ownership interest in MCO of more than 5%, is posted annually at www.moodys.com under the heading “Investor Relations — Corporate Governance — Director and Shareholder Affiliation Policy.”

Additional terms for Australia only: Any publication into Australia of this document is pursuant to the Australian Financial Services License of Moody’s Investors Service Pty Limited ABN 61 003 399 657 AFSL 336969 and/or Moody’s Analytics Australia Pty Ltd ABN 94 105 136 972 AFSL 383569 (as applicable). This document is intended to be provided only to “wholesale clients” within the meaning of section 761G of the Corporations Act 2001. By continuing to access this document from within Australia, you represent to MOODY’S that you are, or are accessing the document as a representative of, a “wholesale client” and that neither you nor the entity you represent will directly or indirectly disseminate this document or its contents to “retail clients” within the meaning of section 761G of the Corporations Act 2001. MOODY’S credit rating is an opinion as to the creditworthiness of a debt obligation of the issuer, not on the equity securities of the issuer or any form of security that is available to retail investors. It would be reckless and inappropriate for retail investors to use MOODY’S credit ratings or publications when making an investment decision. If in doubt you should contact your financial or other professional adviser.

Additional terms for Japan only: Moody’s Japan K.K. (“MKJK”) is a wholly-owned credit rating agency subsidiary of Moody’s Group Japan G.K., which is wholly-owned by Moody’s Overseas Holdings Inc., a wholly-owned subsidiary of MCO. Moody’s Japan K.K. (“MKJK”) is a wholly-owned credit rating agency subsidiary of MJKKKK. MISF is not a Nationalized Recognized Statistical Rating Organization (“NRSRO”). Therefore, credit ratings assigned by MISF are Non-NRSRO Credit Ratings. Non-NRSRO Credit Ratings are assigned by an entity that is not a NRSRO and, consequently, the rated obligation will not qualify for certain types of treatment under U.S. laws. MKJK and MISF also credit rating agencies registered with the Japan Financial Services Agency and their registration numbers are FSA Commissioner (Ratings) No. 2 and 3 respectively.

MKJK or MISF (as applicable) hereby disclose that most issuers of debt securities (including corporate and municipal bonds, debentures, notes and commercial paper) and preferred stock rated by MKJK or MISF (as applicable) have, prior to assignment of any rating, agreed to pay to MKJK or MISF (as applicable) for appraisal and rating services rendered by it fees ranging from JPY200,000 to approximately JPY350,000,000.

MKJK and MISF also maintain policies and procedures to address Japanese regulatory requirements.

To the extent permitted by law, MOODY’S and its directors, officers, employees, agents, representatives, licensors and suppliers disclaim liability for any direct or compensatory losses or damages caused to any person or entity, including but not limited to by any negligence (but excluding fraud, willful misconduct or any other type of liability that, for the avoidance of doubt, by law cannot be excluded) on the part of, or any contingency within or beyond the control of, MOODY’S or any of its directors, officers, employees, agents, representatives, licensors or suppliers, arising from or in connection with the information contained herein or the use or inability to use any such information.