Incorporating Economic Forecasts into CECL

Sohini Chowdhury PhD, Director

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Agenda

1. R&S Economic Forecasts
2. Beyond the R&S Forecast Horizon
3. Simple ECL Solution for Consumer Loans
R&S Economic Forecasts
FASB Requirements

Topic 326 guidance

“The measurement of expected credit losses is based on relevant information about past events, including historical experience, current conditions, and reasonable and supportable forecasts that affect the collectability of the reported amount. An entity must use judgment in determining the relevant information and estimation methods that are appropriate in its circumstances.”

What Makes an Economic Forecast Reasonable and Supportable?

It is produced by a model which

- Is based on sound, generally accepted economic and statistical theory
- Incorporates inter-relationships and feedback effects among variables such that a shock to one factor impacts all other factors over time
- Provides information at varying levels of geographic aggregation to capture local economic effects

Our economic forecasting model meets these criteria
Moody’s Scenarios Cover A Range of Possible Outcomes

Scenario service, monthly updates with narratives and probability weights

Real GDP, % change yr ago

Source: Moody’s Analytics

Scenario Inventory

BAU/CECL-Driven
BL Baseline Forecast (50th pctile)
CB Consensus Baseline
S0 Strong Upside (4th pctile)
S1 Stronger Near-Term Growth (10th pctile)
S2 Slower Near-Term Growth (75th pctile)
S3 Moderate Recession (90th pctile)
S4 Protracted Slump (96th pctile)
S5 Below-Trend Long-Term Growth
S6 Stagflation
S7 Next-Cycle Recession
S8 Low Oil Price
CS Constant Severity
CB Consensus Baseline

Compliance-Driven
FB Fed Baseline
FA Fed Adverse
FS Severely Adverse Scenario

BC Bank-Specific Scenario
How to Use R&S Economic Forecasts in CECL?

Options –

1. Use forecasts and narratives to inform CECL estimate: qualitative overlay approach
2. Select a single scenario to derive “official” CECL estimate: quantitative overlay approach
   » Run shadow scenarios to inform any qualitative adjustments
3. Estimate CECL under several alternative economic scenarios: multiple scenarios approach
   » Compute the probability weighted average as the “official” CECL estimate
4. Estimate CECL under several thousand simulated scenarios: simulated scenarios approach
   » Compute the mean as the “official” CECL estimate
1. Qualitative Overlay Approach

Institution may use a vintage-loss rate approach to estimate CECL.

An expected increase in unemployment within their geography justifies an increase in their loss estimate.
Capture Local Conditions

Dallas is expected to outperform TX, US

Unemployment rate, %

Sources: BLS, Moody’s Analytics
2. Quantitative Overlay Approach

ECL estimation with baseline, adjusted for stress

Institution may use a formal PD-LGD approach with a preferred scenario to estimate “official” ECL

Run shadow scenarios to measure sensitivity to alternative economic scenarios

Qualitatively adjust “official” ECL based in part on these exercises

$$ECL = PD \times LGD \times EAD$$

Quarterly conditional probability of default, %

Baseline
Scenario 3

Qtrs from forecast start
3. Multiple Scenarios Approach (OTS)

ECL estimation with range of scenarios

Institution may use a formal PD-LGD approach with set of alternative scenario to estimate ECL

Range of upside and downside scenarios provide insight into sensitivities

Quantitatively combine ECL estimated from each scenario to compute probability weighted ECL
Multiple Scenarios Approach (Custom)

Use Scenario Studio to tweak Moody’s OTS scenarios to incorporate management’s views

- Web-based application to develop scenarios
- Uses Moody’s Analytics validated macro models
- Forecast governance built into the application
  - Audit trail of edits to assumptions
  - Test edits in a sandbox environment before committing them to the “official” forecast
  - Transparency of equations and assumptions
- Collaborate with colleagues or Moody’s Analytics economists on the same forecast
  - Simultaneous read/write access
Example: 10-Year Treasury Forecast Equation

<table>
<thead>
<tr>
<th>Summary</th>
<th>Specification</th>
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<tbody>
<tr>
<td>Title</td>
<td>Interest Rates: 10-Year Constant Maturity Securities</td>
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<tr>
<td>Code</td>
<td>FRGT10Y_US</td>
</tr>
<tr>
<td>Units</td>
<td>% p.a., NSA</td>
</tr>
<tr>
<td>Dependent Variable</td>
<td>FRGT10Y_US</td>
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<td>Estimation</td>
<td>LS</td>
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<tr>
<td>Sample</td>
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<td>Add Factor Type</td>
<td>Residual Shift</td>
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<td>Historical</td>
<td>IRGT10YD_IUSA</td>
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<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
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<td>FRGT10Y_US(-1)</td>
<td>0.0205226657</td>
<td>0.030012937027</td>
<td>338966</td>
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<td>FRFED_US</td>
<td>0.1592807393</td>
<td>0.025081198666</td>
<td>350605884</td>
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<td>FSPVOL_US</td>
<td>-0.09600012610</td>
<td>0.0755213260-1.269484029</td>
<td></td>
</tr>
<tr>
<td>100* (FGTSOPTQ.US(-1) / FGDP.US(-1))</td>
<td>0.010622114960</td>
<td>0.03211996673</td>
<td>30701306</td>
</tr>
<tr>
<td>@MOVAV(100* (FXMRXQ_US(-1)/FGDP_US(-1)),4)</td>
<td>-0.02424526380</td>
<td>0.01579299541</td>
<td>1.535225153</td>
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</tbody>
</table>

Summary Statistics
- R-squared: 0.0786526042
4. Simulation Approach

ECL estimation with simulated scenarios

Based on 1000 simulations
Based on MA OTS scenarios

Lifetime ECL from different scenarios/simulations

Simulated Average: 8.7%
Simulated Median: 7.4%
Scenario 1: 4.0%
Baseline: 5.1%
Scenario 3: 14.9%
Scenario Weighted Average: 7.7%

Source: Moody’s Analytics
So…which is the Recommended Approach?
Depends on firm size/complexity

<table>
<thead>
<tr>
<th>Approach</th>
<th>Pros</th>
<th>Cons</th>
<th>Recommended Firm Size (by Assets)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single scenario</td>
<td>• Easiest to explain</td>
<td>• Hardest to defend</td>
<td>Smallest</td>
</tr>
<tr>
<td>• Qualitative overlay</td>
<td>• Easiest to implement operationally</td>
<td>• Hard to quantify</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Likely to produce more volatile ECL estimates compared to multiple scenarios</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Depending on the scenario chosen, could produce less conservative ECL estimates compared to multiple scenarios approach</td>
<td></td>
</tr>
<tr>
<td>Single scenario</td>
<td>• Easier to implement than multiple scenarios</td>
<td></td>
<td>Small/Medium</td>
</tr>
<tr>
<td>• Quantitative overlay</td>
<td>• Easy to explain</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Operationally more complex to implement than single scenario</td>
<td>Medium/Large</td>
</tr>
<tr>
<td>Probability-weighted multiple scenarios</td>
<td>• Likely to produce more stable ECL estimates than single scenario</td>
<td>• Operationally more complex to implement than single scenario</td>
<td>Medium/Large</td>
</tr>
<tr>
<td>• Moody’s OTS</td>
<td>• Likely to produce more conservative ECL estimates</td>
<td>• May require additional documentation to support scenario customization</td>
<td></td>
</tr>
<tr>
<td>• Custom</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simulated scenarios</td>
<td>• Produces most accurate ECL estimates</td>
<td>• Operationally most complex, given tight quarterly reporting deadlines</td>
<td>Largest</td>
</tr>
<tr>
<td></td>
<td>• Recognizes future business cycles</td>
<td>• Hardest to explain</td>
<td></td>
</tr>
</tbody>
</table>
Beyond the R&S Forecast Horizon
What is the R&S Forecast Horizon?

Depends on **BOTH** the credit loss models and the economic forecast models

**Credit Loss Models**
- Is the length of observed historical performance sufficient to project losses?
- Is observed history of performance relevant for the future time horizon?
- Is the methodology used reasonable and supportable over the time horizon?

**Economic Forecast Models**
- Are forecasts for forward-looking drivers econometrically determined?
- Are data with limited history being extrapolated?
- Are economic cycles being forecasted in a reasonable fashion?
What to do Beyond the R&S Horizon?

Topic 326 guidance

…for periods beyond which the entity is able to make or obtain reasonable and supportable forecasts of expected credit losses, an entity shall revert to historical loss information …An entity shall not adjust historical loss information for existing economic conditions or expectations of future economic conditions for periods that are beyond the reasonable and supportable period. An entity may revert to historical loss information at the input level or based on the entire estimate. An entity may revert to historical loss information immediately, on a straight-line basis, or using another rational and systematic basis (326-20-30-9)

…some entities will use this reversion technique, while others may have the systems and processes in place to forecast over the estimated life of the financial asset on a reasonable and supportable basis. (BC53)
## Options for Reversion

<table>
<thead>
<tr>
<th>Approach</th>
<th>R&amp;S Forecast Horizon</th>
<th>Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Reversion</td>
<td>Lifetime horizon. <strong>Revert model inputs</strong> to long-term trends.</td>
<td>May lead to low estimates of losses in the out years when scenarios converge.</td>
</tr>
<tr>
<td>Output Reversion</td>
<td>Institution-specific. <strong>Revert model outputs</strong> to historical loss rates immediately or gradually with decay.</td>
<td>Requires definition of historical loss rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• What is the historical time period?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• should we control for credit quality, product, age?</td>
</tr>
</tbody>
</table>

Either approach will need to be defended as reasonable and supportable.
Input Reversion Example

Moody’s Analytics scenarios revert to historical trends in the long-run

U.S. Unemployment rate, %

Sources: BLS, Moody’s Analytics
Output Reversion

Monthly Conditional Loss Rate, %

Assume credit model is reasonable and supportable for 36 months

Source: Moody’s Analytics
OTS ECL Solutions for Consumer Loans
Simple Ways to Compute ECL for Consumer Loans

Use off-the-shelf models from Moody’s Analytics

- **Moody’s Portfolio Analyzer**
  - Account-level estimates for mortgage and auto loan portfolio

- **Moody’s ECCL: Expected Consumer Credit Loss**
  - Cohort-level estimates for all consumer products

Solutions provide lifetime forecasts of Expected Credit Losses under reasonable and supportable scenarios with quick delivery.
Moody’s ECCL: Expected Consumer Credit Loss

- Auto
  - Bank Loans
  - Bank Leases
  - Finance Loans
  - Finance Leases
- Bankcard
- Consumer Finance
  - Installment
  - Revolving
- Mortgage
- Home Equity
  - Installment (HELOAN)
  - Revolving (HELOC)
- Retail
- Student Loans
- Other

13 Asset Class Specific Industry Models
Required Input

» Required Input:
  » Product Category
    » First Mortgage, Auto Bank, etc.
  » Snapshot Date
  » Exposure (Outstanding Balance) by portfolio footprint
    » Unique combination of defined Vintage, Geography, Risk Score Band cohorts
  » Scenario(s):
    » Single scenario or probability-weighted scenario output options
    » Select from Moody’s Analytics Baseline, S1-S8 alternative scenarios, CCAR Scenarios
Industry Default/Optional Overrides

Several Parameters are utilized in ECCL solution with option to override industry default assumptions:

- **Expected Lifetime:** Select default, to equal to term, or other based on research
- **Loss Given Default (LGD):** Asset class specific scalars based on historical information
  - **Data/Model Sources:** Fannie Mae/Freddie Mac, MPA, APA, Auto Cycle, Call Reports Forecasts
- **Optional Discounting:** Select fixed rate or variable scenario-conditioned rate
Your Portfolio + Industry Forecasts = CECL

<table>
<thead>
<tr>
<th>Product</th>
<th>State</th>
<th>Credit Score</th>
<th>Origination Quarter</th>
<th>Outstanding Balance</th>
<th>PD Rate</th>
<th>LGD Rate</th>
<th>ECCL Rate</th>
<th>CECL</th>
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<tr>
<td>Consumer</td>
<td>CA</td>
<td>700-719</td>
<td>2009Q2</td>
<td>$100</td>
<td>4%</td>
<td>99%</td>
<td>4.0%</td>
<td>$4</td>
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<tr>
<td>Consumer</td>
<td>CA</td>
<td>660-699</td>
<td>2011Q2</td>
<td>$300</td>
<td>6%</td>
<td>95%</td>
<td>5.7%</td>
<td>$17</td>
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<tr>
<td>Consumer</td>
<td>CA</td>
<td>660-699</td>
<td>2013Q2</td>
<td>$500</td>
<td>7%</td>
<td>90%</td>
<td>6.3%</td>
<td>$32</td>
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<tr>
<td>Consumer</td>
<td>CA</td>
<td>700-719</td>
<td>2015Q2</td>
<td>$200</td>
<td>4%</td>
<td>85%</td>
<td>3.4%</td>
<td>$7</td>
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<tr>
<td>Consumer</td>
<td>CA</td>
<td>700-719</td>
<td>2017Q2</td>
<td>$700</td>
<td>5%</td>
<td>95%</td>
<td>4.8%</td>
<td>$33</td>
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<tr>
<td>Consumer</td>
<td>CA</td>
<td>700-719</td>
<td>2019Q2</td>
<td>$1,000</td>
<td>6%</td>
<td>95%</td>
<td>5.7%</td>
<td>$57</td>
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<td>$2,800</td>
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<td>$150</td>
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## Results Also in Dashboard Summary

### Aggregate Portfolio

<table>
<thead>
<tr>
<th>Year-End</th>
<th>First/Prepayment</th>
<th>ECL</th>
<th>ECL Ratio</th>
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<tr>
<td>2022</td>
<td>$1,000,000,000</td>
<td>$500,000,000</td>
<td>0.50%</td>
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<table>
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<th>Risk Stage</th>
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<th>ECL</th>
<th>ECL Ratio</th>
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<tr>
<td>AAA</td>
<td>$10,000,000</td>
<td>$1,000,000</td>
<td>0.10%</td>
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<tr>
<td>AA</td>
<td>$9,000,000</td>
<td>$900,000</td>
<td>0.10%</td>
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<tr>
<td>A</td>
<td>$8,000,000</td>
<td>$800,000</td>
<td>0.10%</td>
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<tr>
<td>BBB</td>
<td>$7,000,000</td>
<td>$700,000</td>
<td>0.10%</td>
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### Digital Finance

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<th>Coverage</th>
<th>ECL</th>
<th>ECL Ratio</th>
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<tr>
<td>SBA</td>
<td>$5,000,000</td>
<td>$500,000</td>
<td>0.10%</td>
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<tr>
<td>HSBC</td>
<td>$4,000,000</td>
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<tr>
<td>TSB</td>
<td>$3,000,000</td>
<td>$300,000</td>
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### Credit Strategies

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<th>Strategy</th>
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</table>
|28 | Results Also in Dashboard Summary
| 29 | MOODY'S ANALYTICS

### Exposure: Orig. Risk Score Cohorts

- ECL: Original Risk Score Cohorts
- ECL Rate: Original Risk Score Cohorts

### Exposure: Orig. Vintage Cohorts

- ECL: Original Vintage Cohorts
- ECL Rate: Original Vintage Cohorts

### Exposure: Geographic Cohort

- ECL: Geographic Cohort
- ECL Rate: Geographic Cohort
For More Information…
www.moodysanalytics.com/cecl

CECL’s Forward-Looking Requirement: The Impact Could Be Substantial

Cristian deRitis, PhD, Sr Director, Economics
Timothy Daly, Director, Sales Manager

How Much Will CECL Impact Reserves for First Mortgage Portfolios?

Ever since the Financial Accounting Standards Board announced that accounting standards for loss reserves will move from an incurred-loss method to a forward-looking approach there has been much speculation on how lending institutions will be impacted. To the best of our knowledge, there has been no study that quantifies this impact in a rigorous manner for the industry as a whole, although a few individual lending institutions have conducted their own analysis.

Economic Scenarios: What’s Reasonable and Supportable?

Introduction
The world is awash in forecasts. Politicians, pundits, analysts and even economists are constantly filling the airwaves with their views on economic issues and how the future is bound to unfold. Forecasts often come with an agenda or other motivation in order to nudge policymakers in a particular direction. But even those neutral analysts can differ in their
Q&A
Structural Forecast Model Methodology

Approach used by Federal Reserve, IMF, Central Banks
Macro to Regional Linkages
Interrelationships between all key variables

US MACRO MODEL

STATE AND METRO MODELS
- Cost of Doing Business
- Population/Households
- Output by Industry
- Employment by Industry
- Housing
- Personal Income
- Labor Force/Unemployment
- Consumer Credit Quality
Why Might You Want to Run More Than One Scenario?

- Credit losses are nonlinear:
  - Scenario 1 (4.0% Loss) < Baseline (5.1% Loss) << S3 (14.9% Loss)

- According to Jensen’s Inequality:
  - PD in an average economy < Average PD across all economies

- Loss estimates under single scenarios can be more volatile than probability weighted estimates

- If you do run just one scenario, Baseline or Consensus may understate losses. Either:
  - Make an on-the-top qualitative adjustment
  - Select a more downside scenario such as Scenario 2 to approximate the nonlinearity