CECL for Consumer Lending Portfolios: A Checklist

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Agenda

1. Overview
2. Questions to ask to model owners
3. The case for calibration
4. Impact ratio
5. What’s next?
Overview
Thought Process for CECL Modeling

**Production**
- How quick does it need to be turnaround?
- What governance procedures should be in place?
- Do I have enough IT capacity for processing and frequent runs?

**Qualitative Adj.**
- How do I determine and defend reasonable and supportable horizon?
- Is management overlay allowed?

**Outcome**
- How do I assess model performance? How often should I?
- What kind of validation is needed for CECL?
- Are my forecasts stable?
- How to perform attribution analysis?
- Are all the stakeholders on same page on outcomes?

**Scope**
- Who and what is subject to CECL?
- How much should accounting to be involved in decisions?

**Inputs**
- Do I need my own data?
- Macroeconomic forecasts?
- What should be the granularity of my data?
- What should be the sample period?

**Methodology**
- Segmentations?
- What methodology is appropriate?
- Will the models have dual use?
- What drivers are needed?
- Are prepayments / delinquencies necessary?
- How to define / calculate lifetime?
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Questions to Ask To Model Owners
Key Data Fields

Borrower & Loan Data
(for all retail asset classes)

» Borrower characteristics: credit history, location (state and zip code), employment status, primary/secondary income, credit quality, borrower age, debt-to-income ratio

» Loan characteristics: origination information (date, term, balance, interest rate, scheduled payment, etc.),

» Performance data: status, current balance, actual payment, modifications, etc.

Securitized Loans
(for mortgage and auto)

» Asset characteristics: product type, purchase price, occupancy/property/purpose type, current value, etc..
LGD and EAD Data

Loss Given Default

» Collateral data is needed for secured products
» Timing of recoveries is required if applying DCF method
» Should institutions include recoveries for existing and future defaults?

Exposure at Default

» Future new accounts are excluded
» Future draws on unfunded commitment are excluded if it’s unconditionally cancellable (HELOCs might not be)
» Pay-down curves of revolving products are essential
Troubled Debt Restructurings (TDR)

**CECL guidelines retain the concept of a TDR:**

- Do not change the criteria used to determine whether a modification of a loan constitutes a TDR.
- Continue to require a TDR to be accounted for as a continuation of the original financial asset when identified.

**Challenges and Changes:**

- TDR impact on expected losses. Reasonably expected TDRs need to be accounted for using DCF method.
- TDR definition is important. General institution specific policy matters.
- Term extensions and interest rate concessions can complicate things, e.g. delaying prepayments and increasing behavioral lifetimes.
- The EIR on a TDR can be based on the original contract.
Common Product Segmentations

Auto / Recreational

Card (Bank Card, Retail Card)

Consumer Loans / Personal Finance

Mortgage

Home Equity

Student Loan

Loans, Leases, New Car/Used Car, RV, Boat, Motorcycle

Promo/Non-promo, Transactors/Revolvers, New/Existing Accounts, Secured/Unsecured

Secured/Unsecured, Installment/Revolving

First Lien/Second Lien, Fixed/ARM, Conforming/Non-conforming

HELOC/HELOAN, First Lien/Second Lien

Private/Gov’t, Different Repayment Plans, Refinance, Deferment, Forbearance
CECL Models Should Consider Current and Future Economic Conditions

Models should include national and/or regional economic variables

» **Economic/Household Performance**
  GDP Growth, Disposable Income Growth

» **Labor Markets**
  Unemployment, Job/Wage/Salary Growth

» **Demographics**
  Population, Number of Households, Migrations etc.

» **Real Estate Markets**
  Home Prices, Home Sales, Housing Starts/Permits

» **Financial Markets**
  Federal Reserve Interest Rates, Equity Market Indexes
Common Drivers of Credit Loss Models
for Consumer Portfolios

» Segment
» Life Cycle / Maturation Component
» Vintage Quality Variables
» Updated Credit Quality Variables*
» Time-Varying Macro Conditions
» Segment × Macro Factor Interactions
» Seasonality Dummies + Other Dummies
» Delinquencies **

* These will be highly correlated with macro variables and can be used in lieu of them, e.g. Current LTV
** Could be drivers of losses, will need data support and use can be decided based on complexity of inclusion
CECL Acceptable Methodologies
FASB guidelines are not prescriptive

Primary Methodologies
» Loss rate method (Pool/cohort/vintage)
» Probability of default method (Pool/cohort/vintage, loan level analysis)
» Roll rate method (Migration analysis/Transition Matrices) (Pool or loan level analysis)
» Discounted cash flow analysis (loan level analysis)

Estimation Techniques
» Model specification is defined based on features of performance metrics (binary, continuous, bounded, etc.)
» Standard candidates include OLS, Log OLS, (multinomial) Logit, Probit, Tobit and Fractional Logit
» Discrete time hazard models with or without competing risks
» Markov chain credit migration
» Machine learning
Pros and Cons

By key factors

Portfolio Materiality

- Loan Level
- Transition

Data availability

Stability

- Loan Level
- Transition
- Cohort Level

Ease of Implementation

Top Down

Cohort Level

Top Down
### Pros and Cons of Different Approaches

<table>
<thead>
<tr>
<th></th>
<th>Top-down Loss Rate</th>
<th>Cohort Vintage</th>
<th>Transition</th>
<th>Loan Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Portfolio</strong></td>
<td>• Only suitable for homogeneous portfolio</td>
<td>• Can be applied to portfolio of different sizes and segments</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Data requirement</strong></td>
<td>• Low: historical loss rates at aggregated level + latest snapshot(s) at cohort level</td>
<td>• Medium: historical performance data at cohort level + latest snapshot at cohort level</td>
<td>• High: historical performance data at loan level + latest snapshot at loan level</td>
<td>• High: historical performance data at loan level + latest snapshot at loan level</td>
</tr>
<tr>
<td></td>
<td>• Quarterly or monthly</td>
<td>• Quarterly or monthly</td>
<td>• Monthly for stage transition; quarterly or monthly for score transition</td>
<td>• Quarterly or monthly</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Score transition requires scores being refreshed at a frequency not lower than data frequency</td>
<td>• Data should be reasonably populated with minimal or no skipping or truncation issues</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Estimation</strong></td>
<td>• Easy to estimate</td>
<td>• Moderate</td>
<td>• Complex</td>
<td>• Complex</td>
</tr>
<tr>
<td></td>
<td>• High maintenance due to relatively low stability</td>
<td>• High stability</td>
<td>• Captures all intermediate and final stages within one framework</td>
<td>• High stability</td>
</tr>
<tr>
<td></td>
<td>• Re-estimation required if there are substantial changes in lending policy or portfolio mix</td>
<td>• RE-estimation required if pooling strategy changes</td>
<td>• Trade-off between consistency and granularity</td>
<td>• Results can be assessed at account level, segment level, or portfolio level</td>
</tr>
<tr>
<td><strong>Other use cases</strong></td>
<td>• Stress testing</td>
<td>• Stress Testing, Planning</td>
<td>• Stress testing, pricing and planning</td>
<td></td>
</tr>
<tr>
<td><strong>Implementation / Production</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Easy to Moderate</td>
<td>• Moderate</td>
<td>• Complex</td>
<td></td>
</tr>
<tr>
<td><strong>Attribution &amp; Disclosure</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Moderate</td>
<td>• Complex</td>
<td>• Easy; results can be aggregated and compared at any level</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Attributions analysis are limited</td>
<td>• Multiple runs required to track model / segment changes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Disclosure pools</td>
<td>• Light calibration required when modeling segmentation differs from disclosure pooling</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Industry Prepayment Rates (%)
Varies by product

Average Annualized Prepayment Rates

- Student Loan
- HELOAN
- First Mortgage
- Consumer Installment
- Auto Finance Lease
- Auto Bank Lease
- Auto Finance Loan
- Auto Bank Loan

MOODY'S ANALYTICS
CECL for Consumer Lending Portfolios 15
CECL Credit Card Paydown Methodology

$ mil, 09Q4 Booking and 10Q2 Balance Sheet

Sources: CFPB, Equifax, CreditForecast.com, Moody’s Analytics
What about the Forecast Horizon?
CECL requires a LIFETIME estimate composed of a forecast and reversion period

LIFETIME EXPECTED LOSS ESTIMATE
CECL estimate over life of each asset based on historical information, current conditions and reasonable and supportable forecasts

FORECAST OVER R&S PERIOD
Depends on credit loss model and economic forecasts

REVERSION PERIOD
Reversion of forecasted losses

Reporting date
Loan termination
Mean Reversion Example

Monthly Loss Rate, %

For illustration purposes only.

Assume credit model is reasonable and supportable for 36 months.
The case for calibration
Loss Forecasting Based on Industry Trends
Conditional loss rate, % of balance, annualized

Sources: Moody’s Analytics
Top Down Approach
For small institutions, immaterial and/or young portfolios

» The approach requires
  – Historical loss rates at aggregate level
    › Banks’ and credit unions’ historical loss rates are available through Moody’s call report forecasts and credit union forecasts
    › Adjust loss rate forecasts to reflect the nature of run-off portfolios
  – Recent performance data at pool / account level: origination & maturity dates, balance, credit score, LTV, etc.
    › Select a reasonable “look-back” period
  » Adjust top down loss forecasts for each pool by considering recent experience and future conditions
How Will CECL Impact a Bank’s Loss Allowance?

“Prediction is very difficult, especially if it is about the future.” Niels Bohr

Depends on a number of factors including but not limited to:

- Contractual term of loans / Lifetime assumption / Methodology for paydown
- Reasonable and supportable period / Mean reversion technique
- Credit quality
- Geography
- Scenario assumptions
- LGD assumptions
- Stage of economic and product credit cycle
- Modeling methodology
- Size and concentration of institution
- Qualitative adjustments
- Current incurred loss method (forward, backward/look-back period)
History of Consumer Default Volumes by Product

Default balances, $ bil, 12-mo MA

Sources: Equifax, Moody’s Analytics
Single Auto Cohort CECL Example

Gross Losses, 2015Q1, Near Prime, 60m term loans, Million $

Sources: CreditForecast.com, Moody’s Analytics
# Key Assumptions that Would impact CECL

## Comparison by model types

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Top-down Loss Rate</th>
<th>Cohort Vintage</th>
<th>Transition</th>
<th>Loan Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimation Approach</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Scenario Conditioned</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Lifetime Assumption</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Reasonably and Supportable Period</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Qualitative Adjustment</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Segmentation</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Default Definition</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Recovery Window</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Look-back period</td>
<td>Yes</td>
<td>Yes if using off-the-shelf models</td>
<td>Yes if using off-the-shelf models</td>
<td>Yes if using off-the-shelf models</td>
</tr>
</tbody>
</table>
5

What’s Next?
Conclusions
How to select appropriate methodologies

» CECL standards are not prescriptive

» Institutes should evaluate all components before making a decision

» Choosing the best methodology depends on many parameters: data availability, size and complexity of a portfolio, business needs, development, implementation and production cost, etc.

» Unified solutions across portfolios are not necessary but might be desired to help with auditors/validators (will need to justify reasons for differences)

» Attribution of the loss variations and loss stability need be closely monitored
What’s Next?

» Sensitivity analysis?
» Validation?
» Buy-in from other departments?
» Linking loss forecasting with originations
» Volatility of reserves quarter over quarter, monitoring results
» Attribution analysis, other disclosures
Major Concern: CECL Model Output Stability

CECL by Reporting Dates, for Illustration Purposes Only ($ Mil.)

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

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

For More Information…
www.moodysanalytics.com/cecl
Moody’s Analytics ECCL

A cohort level solution that couples user inputs with industry data and models

ECCL (Expected Consumer Credit Losses) is an extension of CreditForecast.com, a Moody’s Analytics and Equifax joint product

– Extends the forecast to encompass the life of the loan
– Computes lifetime ECL values for user inputted portfolio footprint (Risk Score X Origination Vintage X Geography)
– Users have the flexibility to use industry standard settings or override with their own assumptions for necessary parameters (e.g. LGD and the expected life of the loan)

<table>
<thead>
<tr>
<th>State</th>
<th>Orig. Score</th>
<th>Orig. Quarter</th>
<th>Outstanding Balance</th>
<th>PD*</th>
<th>LGD</th>
<th>ECL Rate</th>
<th>ECL</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>700-719</td>
<td>2009Q2</td>
<td>$100</td>
<td>4%</td>
<td>40%</td>
<td>1.6%</td>
<td>$1.6</td>
</tr>
<tr>
<td>CA</td>
<td>660-669</td>
<td>2011Q2</td>
<td>$300</td>
<td>6%</td>
<td>40%</td>
<td>2.4%</td>
<td>$7.2</td>
</tr>
<tr>
<td>CA</td>
<td>660-669</td>
<td>2013Q2</td>
<td>$500</td>
<td>7%</td>
<td>40%</td>
<td>2.8%</td>
<td>$14.0</td>
</tr>
<tr>
<td>CA</td>
<td>700-719</td>
<td>2015Q2</td>
<td>$200</td>
<td>4%</td>
<td>40%</td>
<td>1.6%</td>
<td>$3.2</td>
</tr>
<tr>
<td>CA</td>
<td>700-719</td>
<td>2017Q2</td>
<td>$700</td>
<td>5%</td>
<td>40%</td>
<td>2.0%</td>
<td>$14.0</td>
</tr>
<tr>
<td>CA</td>
<td>700-719</td>
<td>2017Q3</td>
<td>$1000</td>
<td>6%</td>
<td>40%</td>
<td>2.4%</td>
<td>$24.0</td>
</tr>
<tr>
<td>CA</td>
<td>700-719</td>
<td>2017Q4</td>
<td>$800</td>
<td>4%</td>
<td>40%</td>
<td>1.6%</td>
<td>$12.8</td>
</tr>
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<td>…</td>
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</tr>
</tbody>
</table>

*PD is the cumulative probability of default over the industry default/user supplied assumed remaining life of loan. For illustration purposes only.
Moody’s Credit Cycle Standard Model

Loss forecasting models based on CreditForecast.com

» Cohort/Vintage Pooled time series

» Fractional logit models of default rates

» Primary Model Drivers
  – Life Cycle/Maturation Component
  – Vintage Quality Variables
  – Time-Varying Macro Conditions
  – Seasonality Dummies
  – Delinquency Roll Rates/Daisy Chain
  – Segment × Macro factor interactions

Bankcard Default Rate, % of Outstanding Balance
Moody’s Portfolio Analyzer™
A loan level solution that fits various data availabilities

» Loan-level econometric models for default, prepayment, and severity for various types of mortgages including HELOCs and HELOANs, and Auto

» Macro-economic factors at national, state, and MSA levels

» Built-in vintage effects, lifecycle, and business cycles

» Calculates contractual and credit-risky cash flows over the life of the loan

» Provides discounted cash flows using the effective interest rate

<table>
<thead>
<tr>
<th>Off-the-shelf</th>
<th>Calibrated</th>
<th>Custom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used when no history available</td>
<td>Off-the-shelf models back-tested on historical performance data</td>
<td>Models built using client data only</td>
</tr>
<tr>
<td>Limited knowledge of underlying models</td>
<td>Models calibrated across different segments</td>
<td>Full transparency of underlying methodology</td>
</tr>
</tbody>
</table>
# Moody’s Analytics LGD Solutions

<table>
<thead>
<tr>
<th>Solution</th>
<th>Asset Class and Granularity</th>
<th>Key Model Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fannie Mae/Freddie Mac Mortgage</td>
<td>Loan level fixed-rate mortgage</td>
<td>Default balance, sales proceeds, expenses, MI and non-MI recoveries, age, credit score, LTV, geo, macroeconomic condition</td>
</tr>
<tr>
<td>MPA/APA</td>
<td>Loan level mortgage and home equity loans / lines Loan level auto loans</td>
<td>LTV, liquidation balance, time to liquidation, property and occupancy information, geo, lien position</td>
</tr>
<tr>
<td>AutoCycle</td>
<td>Auto data at 11-digit VIN level</td>
<td>Vehicle characteristics, style types, macroeconomic condition</td>
</tr>
<tr>
<td>CRF</td>
<td>Bank call report data at firm level, all asset classes</td>
<td>Charge-offs, macroeconomic condition</td>
</tr>
<tr>
<td>Credit Union Forecasts</td>
<td>Credit union call report data at firm level, all asset classes</td>
<td>Charge-offs, macroeconomic condition</td>
</tr>
</tbody>
</table>
Consensus Scenario

This scenario is designed to incorporate the central tendency of a range of baseline forecasts produced by various institutions and professional economists.

- The probability that the economy will perform better than this consensus is equal to the probability that it will perform worse.
- The consensus scenario is based on a review of publicly available baseline forecasts of the U.S. economy. These sources include:
  - Congressional Budget Office
  - Social Security Administration
  - Federal Open Market Committee members’ range of forecasts
  - Federal Reserve Comprehensive Capital Analysis and Review baseline
  - European Commission U.S. baseline
  - U.K. Prudential Regulation Authority U.S. baseline
  - Philadelphia Federal Reserve Survey of Professional Forecasters

Note: Assumptions for all other MA scenarios available
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