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CECL Quantification:
Retail Portfolios

March 2017

Today's Speakers

» **Dr. Shirish Chinchalkar** is a Managing Director in the Economics and Structured Analytics group.

» Responsible for the Portfolio Analyzer platform for analyzing the credit risk of US residential mortgages, US auto loans, Asset-Backed Securities, and UK and Dutch residential mortgages

» Prior to joining Moody's, he was an Assistant Professor at IIT Bombay and a researcher at Cornell University

» PhD from Cornell University

» **Dr. Cristian deRitis** is a Senior Director in the Economics and Structured Analytics group.

» Conducts economic analysis and develops econometric models for a variety of clients

» Analysis and commentary on consumer credit, housing, and the broader economy appear on the firm's Economy.com web site

» Named on two US patents for credit risk modeling techniques

» PhD from Johns Hopkins University

Moderator

» **Anna Krayn** is a Senior Director and Team Lead, responsible for solution structuring across Moody's Analytics products and services focusing on impairment, stress testing, and capital planning solutions.

» Prior to her current role, she was with Enterprise Risk Solutions as engagement manager leading projects with financial institutions across Americas in loss estimation, enhancements in internal risk rating capabilities and counterparty credit risk management.

» Ms. Krayn holds a B.S. and MBA from Stern School of Business at New York University.

Welcome!

**Moody's Analytics CECL Webinar Series:
Expected Credit Loss Quantification**

Introduction to CECL Quantification
Tuesday, February 14, 2017 | 1:00PM EST

CRE CECL Methodologies
Tuesday, February 28, 2017 | 1:00PM EST

C&I CECL Methodologies
Tuesday, March 14, 2017 | 1:00PM EDT

Retail CECL Methodologies
Tuesday, March 28, 2017 | 1:00PM EDT

**Structured Assets CECL Methodologies**
Thursday, April 20, 2017 | 1:00PM EDT

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2. Please select it, so that the icon is blue (as shown).

3. Select your answers in the Polling section that appears in the right hand panel of the platform.

4. Results will display after the poll has ended.
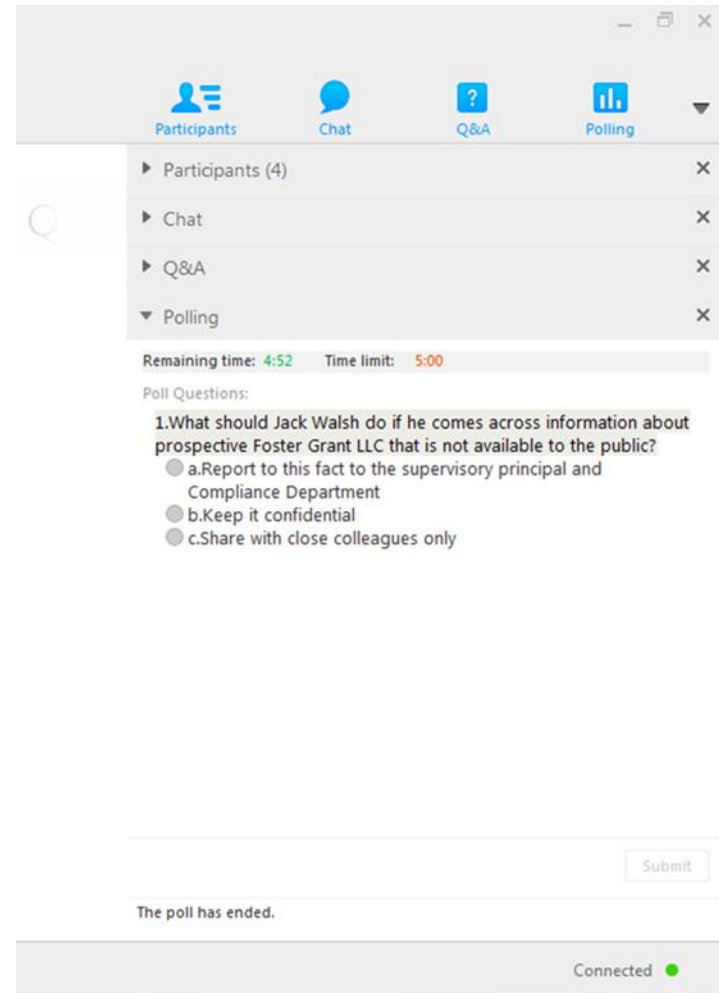
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The CECL Revolution:
Accounting, Economics, and Risk Intersect

Institutions will need to measure and record immediately all expected credit losses (ECL) over the life of their financial assets based on:

1) Past events, including historical experience

2) Current conditions

3) Reasonable and supportable forecasts

ECL recorded at origination and updated at subsequent reporting dates

Rules provide guidelines, but not specific guidance. Institutions will have significant discretion over how they measure expected credit losses.

Key Decisions for Providing CECL Estimates for Retail

Methodology
- Which methods are acceptable?
- Can I leverage existing models?

Economic Scenario
- Which scenario is defensible?
- How many?

Lifetime Definition
- Contractual or behavioral life?
- Life of revolving account?

Benchmarking
- What's required? Best practice?
- What are options for retail credit?

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Methodology

CECL Methodology for Retail Credit

» Guidance gives banks wide discretion:

– Loss rate, PD/LGD, vintage analysis, etc.

» Choice of CECL methodology depends on

– Portfolio materiality and institution size

– Data availability

– Development cost

  » Short-term vs. long-term investment

– Availability of existing models

» Unlike some other asset classes, retail credit typically…

– ...has lots of data

– …has lots of models (origination scorecards, pricing models, stress testing, etc.)

» Industry-derived forecasts provide a low cost solution for smaller institutions

Main Methods for Retail Credit

Portfolio-level models

» Modeling losses at the asset class level is straightforward and less expensive

» Can capture broad sensitivities of performance to economic events

» Assumes consistency of portfolio profile. Ignores seasoning (or aging) of loans.

Loan-level models

» Loan-level models have the advantage of delivering loan-level forecasts and being able to control for heterogeneity within a portfolio.

» Most complex and flexible.

Vintage-cohort models

» Cohorting loans by common characteristics such as vintage, credit score, etc. can provide a happy medium between portfolio and loan level

» Identify key areas of risk within a portfolio while maintaining model stability.

» Link macroeconomic scenarios to credit risk parameters.

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Leveraging Existing Models for CECL

COMPLEXITY AND VOLATILITY

Current Approach

Gap to CECL

TTC Loss Estimation (PD / LGD / EAD)
- ☑ Incorporates historical experience
- ❑ Incorporates current conditions

- ❑ Incorporate forecasts
- ❑ Forecast life of loan ECL
- ? Segment-appropriate

PIT Loss Estimation (PD / LGD / EAD)
- ☑ Incorporates historical experience
- ☑ Incorporates current conditions

- ❑ Incorporate forecasts
- ❑ Forecast life of loan ECL
- ? Segment-appropriate

Stress Testing Loss Estimation (PD / LGD / EAD)
- ☑ Incorporates historical experience
- ☑ Incorporates current conditions

- ☑ Incorporate forecasts
- ? Forecast life of loan ECL
- ? Segment-appropriate

Enhance Strategy

OR

Replace Strategy

Economic Scenarios

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Moody's Analytics Structural Macro Model
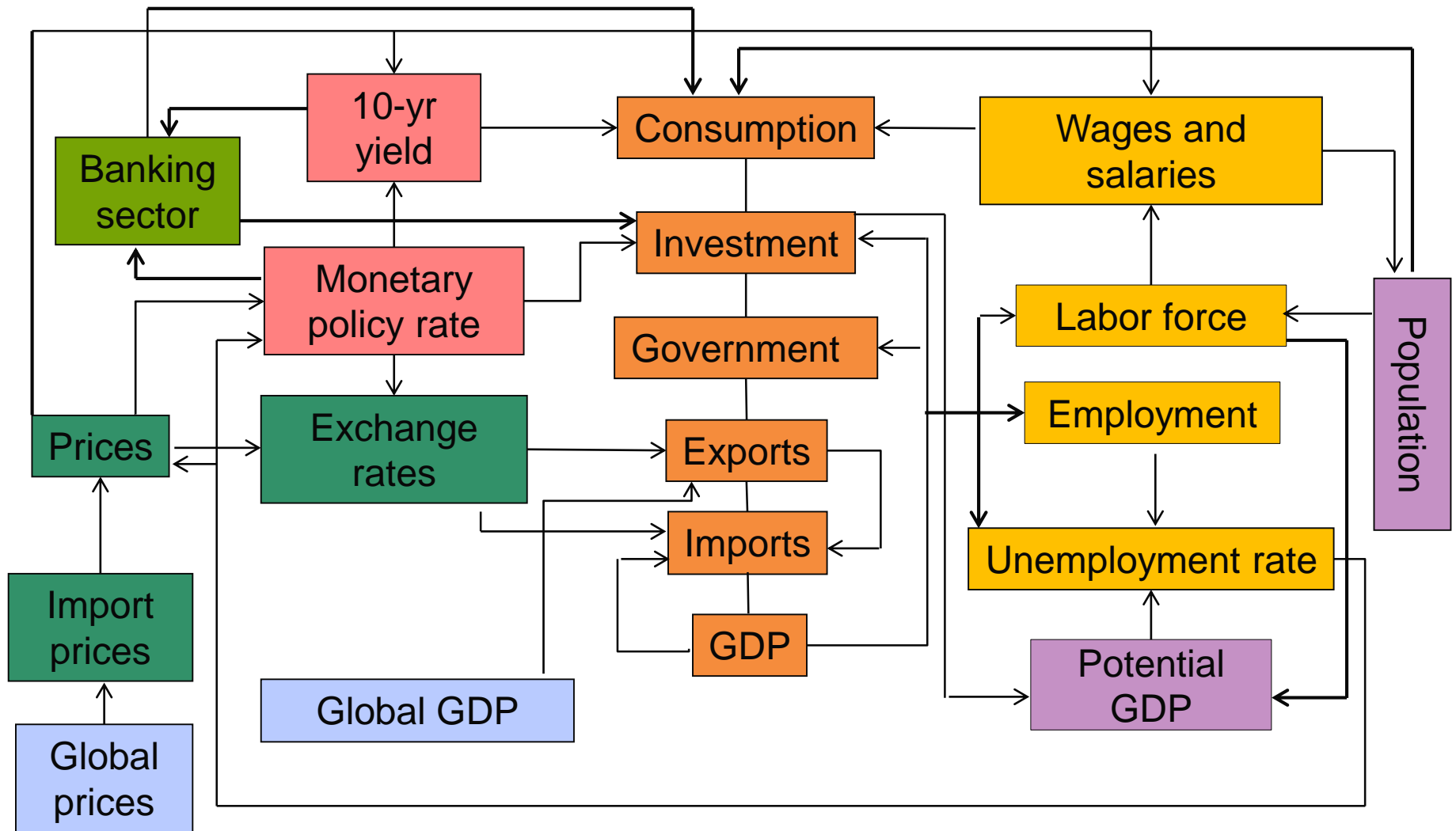
Moody's Analytics Forecast Models

US Macroeconomic model

Country models

State-level models

Financial metric models

Metro-level models

House price models
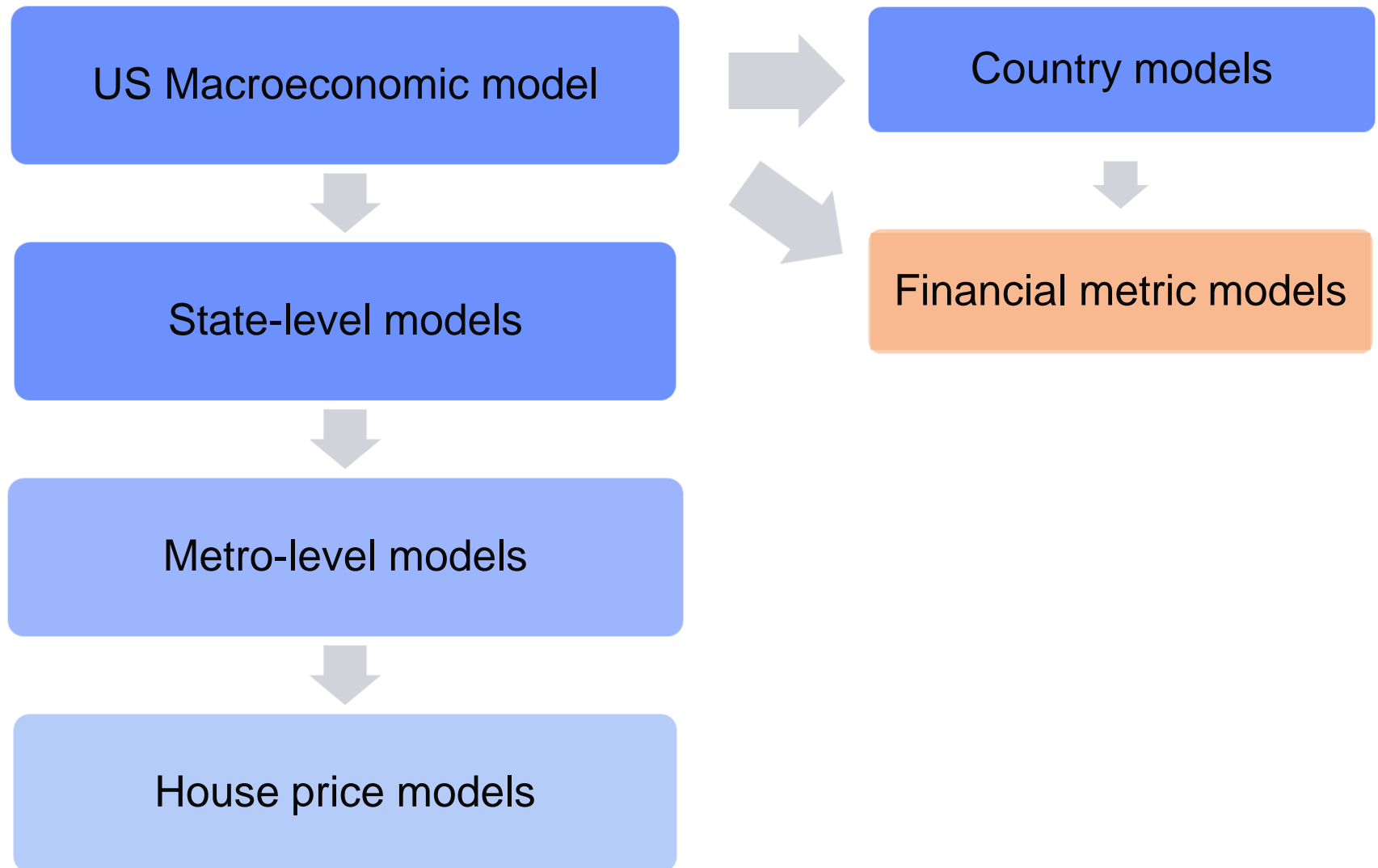
How many economic scenarios do you plan to run for CECL?

a. One, baseline

b. Two, consensus

c. Multiple, probability weighted

d. Other

e. Not sure

Moody's Macroeconomic Scenarios

Standard Simulated Scenarios

| BL | Baseline (50th pct) |

| S1 | Stronger Near-Term Rebound (10th pct) |

| S2 | Slower Recovery (75th pct) |

| S3 | Moderate Recession (90th pct) |

| S4 | Protracted Slump (96th pct) |

| CF | Consensus Forecast |

| USER | Custom/Bespoke |

Range of Alternative Macro Scenarios Available

Real GDP growth rate, % Yr/Yr
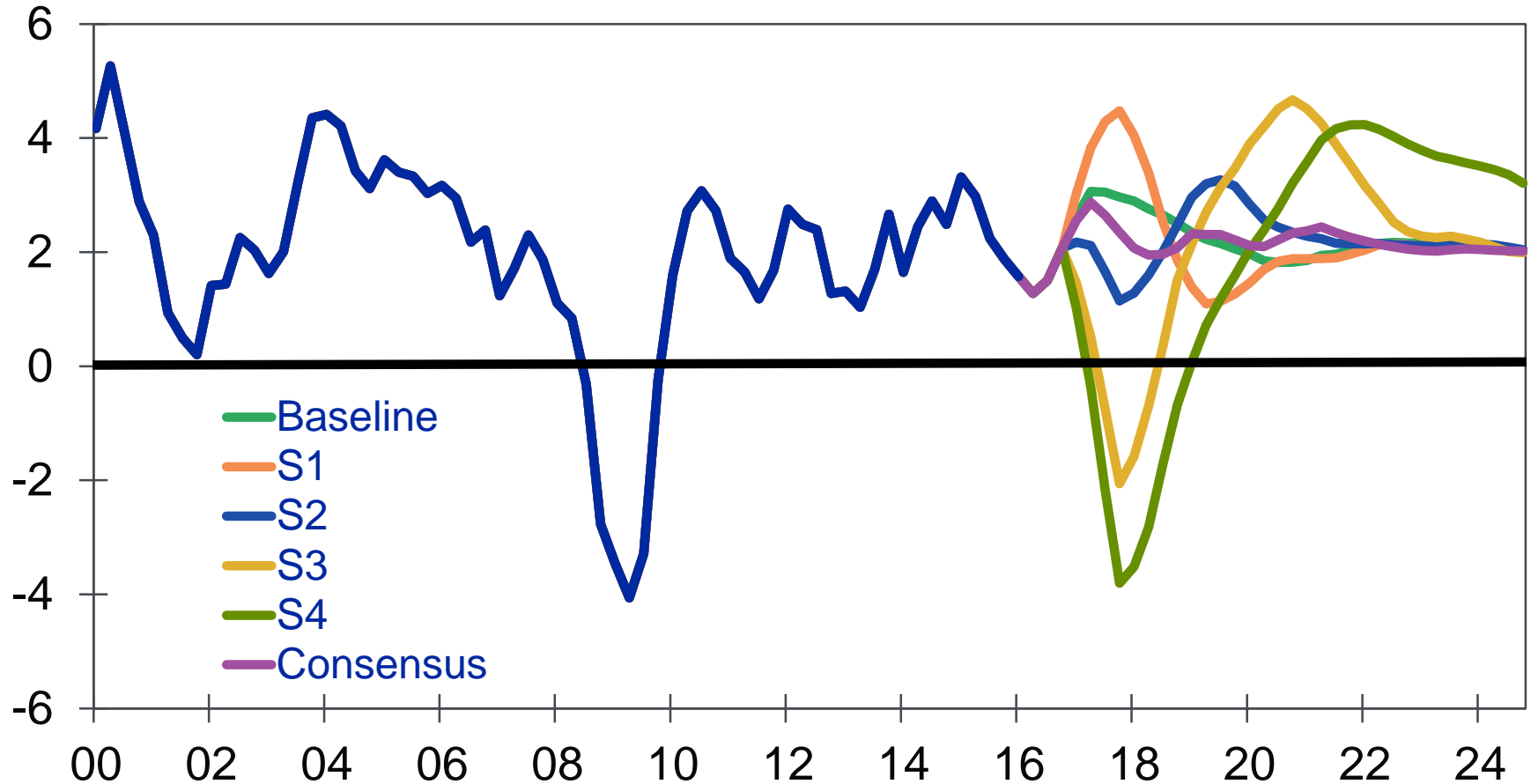
Sources: BEA, Moody's Analytics

Lifetime Definition

Lifetime Length Determination Depends on Asset

CREDIT TYPE	EXAMPLES OF PRODUCTS	APPROACH FOR LIFETIME LENGTH DETERMINATION
NON-REVOLVING CREDIT	**MORTGAGES** **LOANS** **AUTO-LOANS**	**USE CONTRACTUAL END DATE TO IDENTIFY LIFETIME LENGTH**
REVOLVING CREDIT	**CREDIT CARDS** **CURRENT ACCOUNTS**	**USE DATE OF PERIODIC REVIEWS OR MODEL BEHAVIORAL LIFE OF PORTFOLIO**

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Behavioral Analysis: Industry-level Charge-offs by Age

Pct of total charge-off dollars
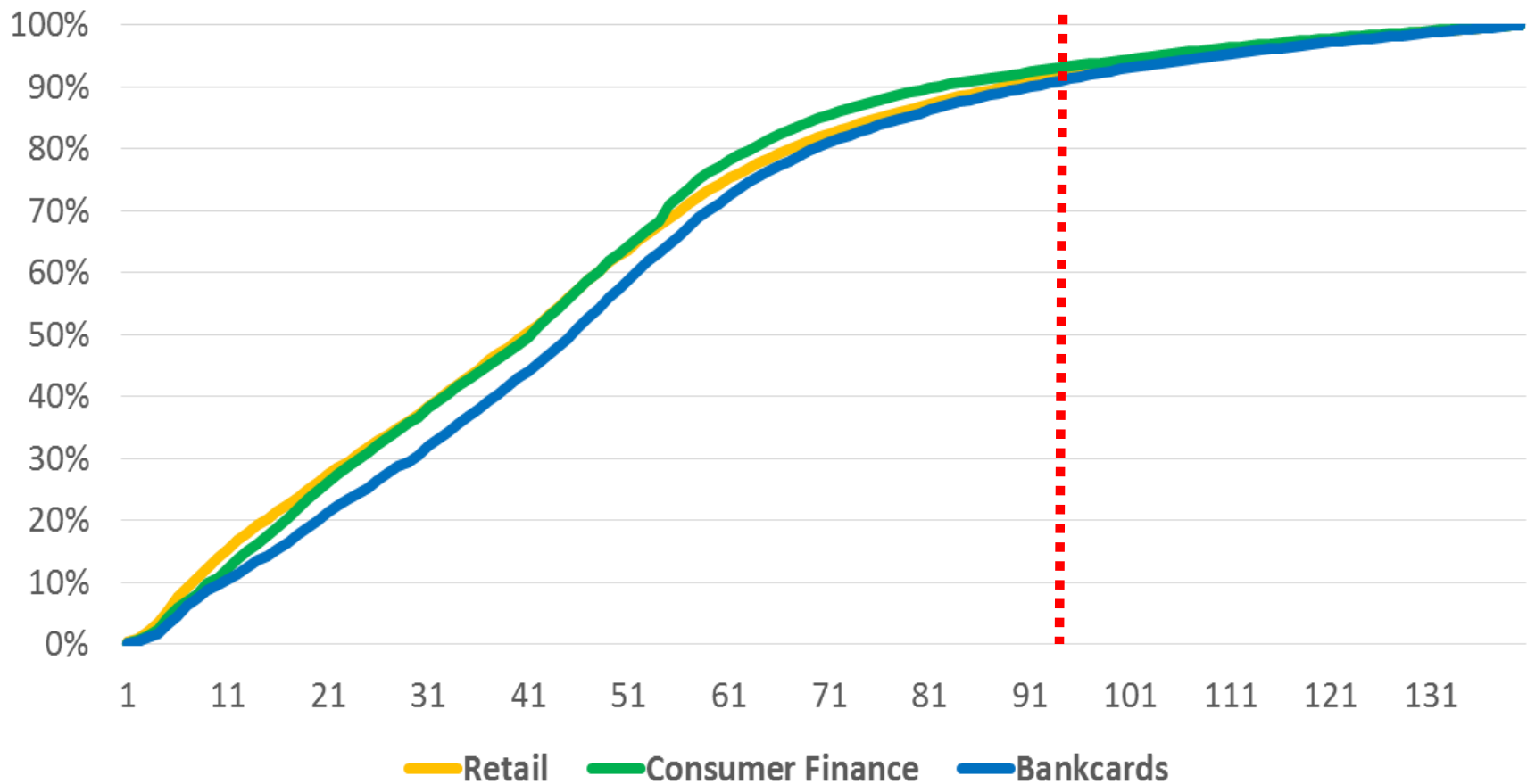
Sources: Equifax, Moody's Analytics

Payment application in the real world

Outstanding balances, $

Pay down cash-advance balances first then purchases…

Legend: Charge off, Accrual, Bal. Transfer, Purchase, Orig. Balance, Cash advance, Total Balance
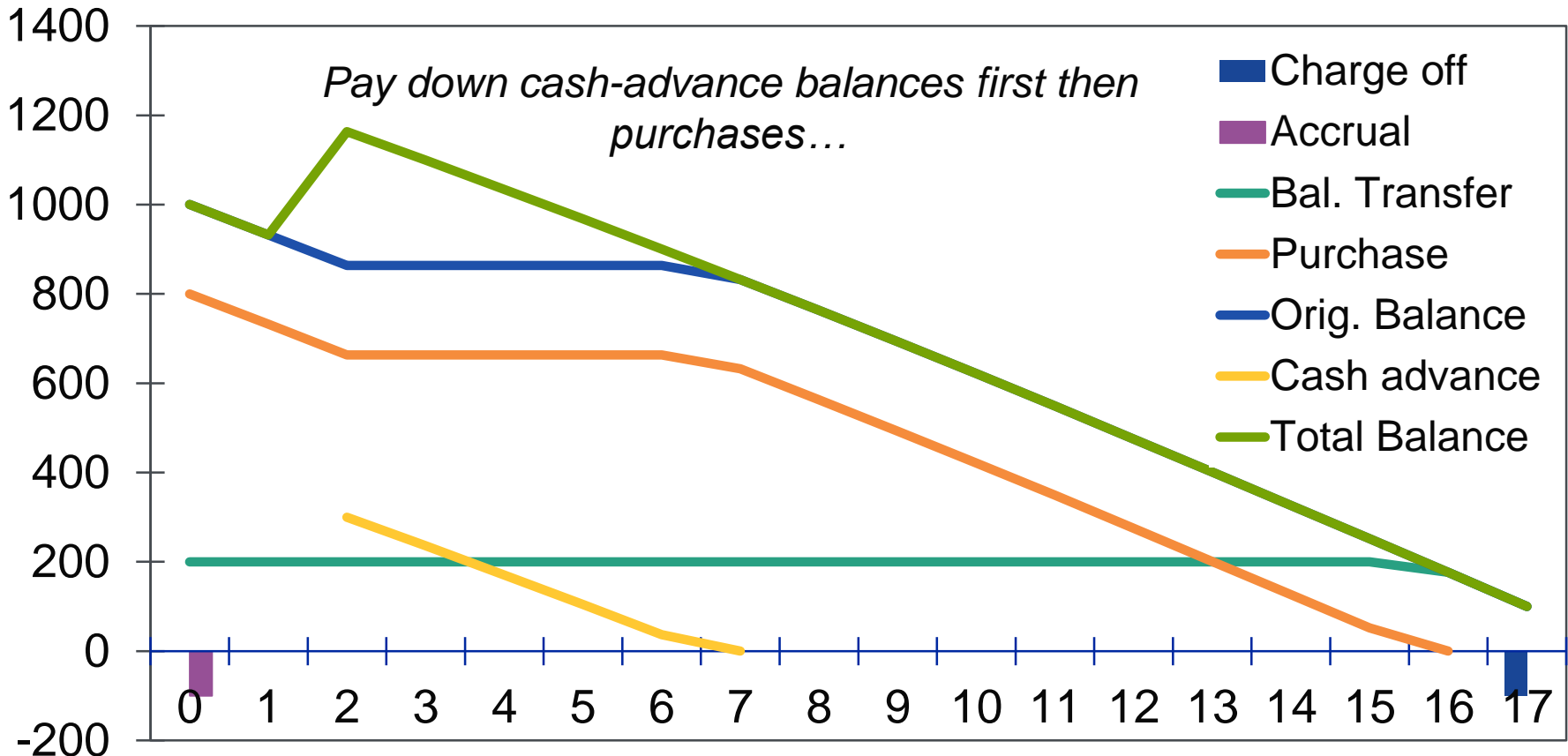
Sources: Moody's Analytics

Ignoring future draws for CECL

Outstanding balances, $

Assume payments are FIFO: Pay down purchase balances first.

Consider new draws after they happen

Legend:
- Charge off
- Accrual
- Bal. Transfer
- Purchase
- Orig. Balance
- Cash advance
- Total Balance
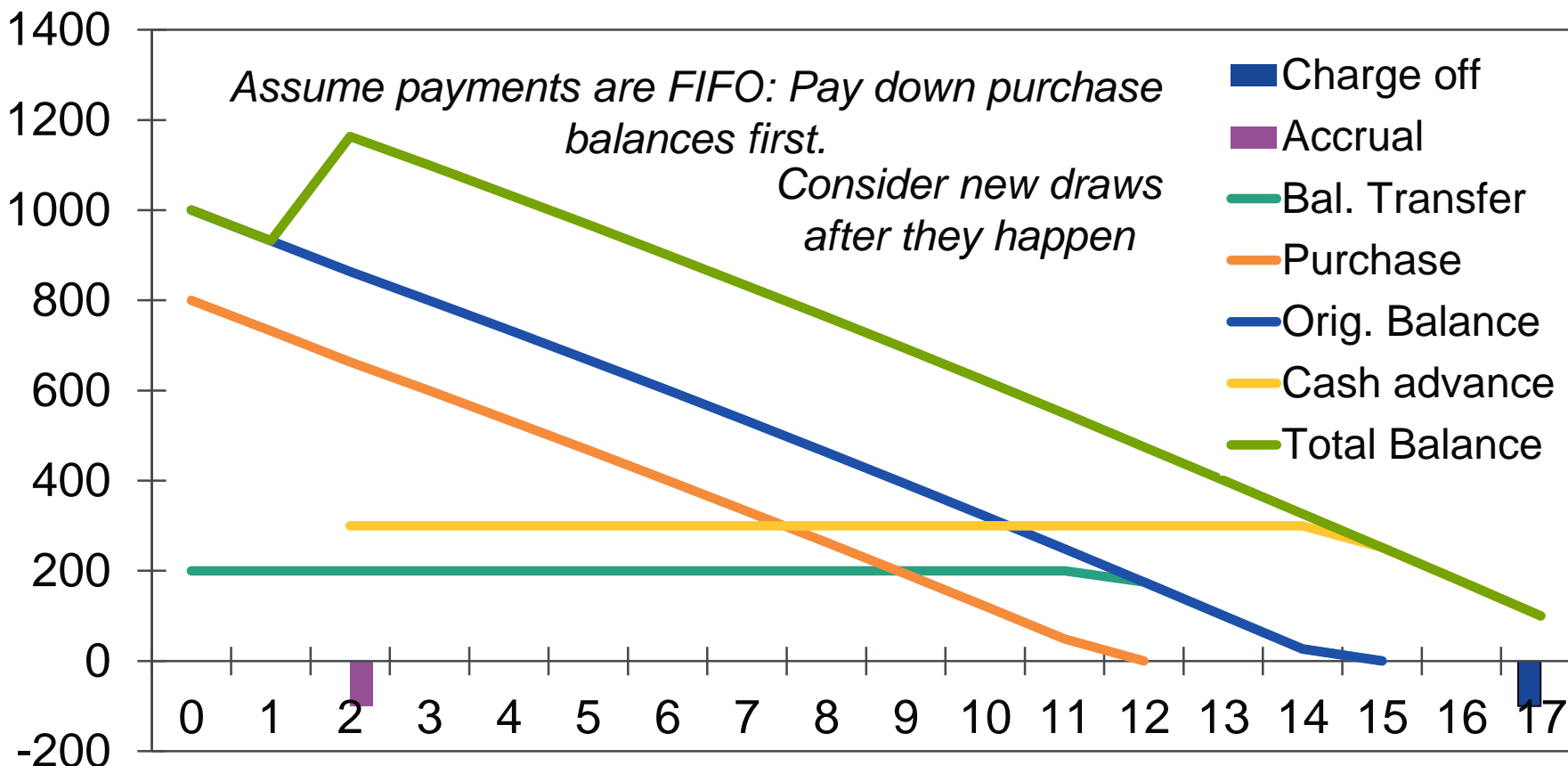
Sources: Moody's Analytics

Do you have sufficient data and expertise to build reasonable supportable CECL models for your retail portfolios?

a. Yes. I have lots of data and modelers. Thanks!

b. No. I have sufficient data but few modeling resources.

c. No. I have modelers but my data is insufficient.

d. No. I don't have enough data or modelers. Help!

e. I'm not sure.

Case 1: CECL with industry-level models

Applying Standard Forecasts To A Portfolio

Suppose we have a portfolio of credit cards originated at different points in time with different credit scores:

Product	State	Credit Score	Origination Quarter	Outstanding Balance
Bankcard	CA	700-719	2009Q2	$100
Bankcard	CA	660-699	2011Q2	$300
Bankcard	CA	660-699	2013Q2	$500
Bankcard	CA	700-719	2015Q2	$200
Bankcard	CA	700-719	2017Q2	$700
Bankcard	CA	700-719	2019Q2	$1,000
Sum				**$2,800**

Industry-level Forecasts by Product-Vintage-Score-Geo

Default rate, % of outstanding balance
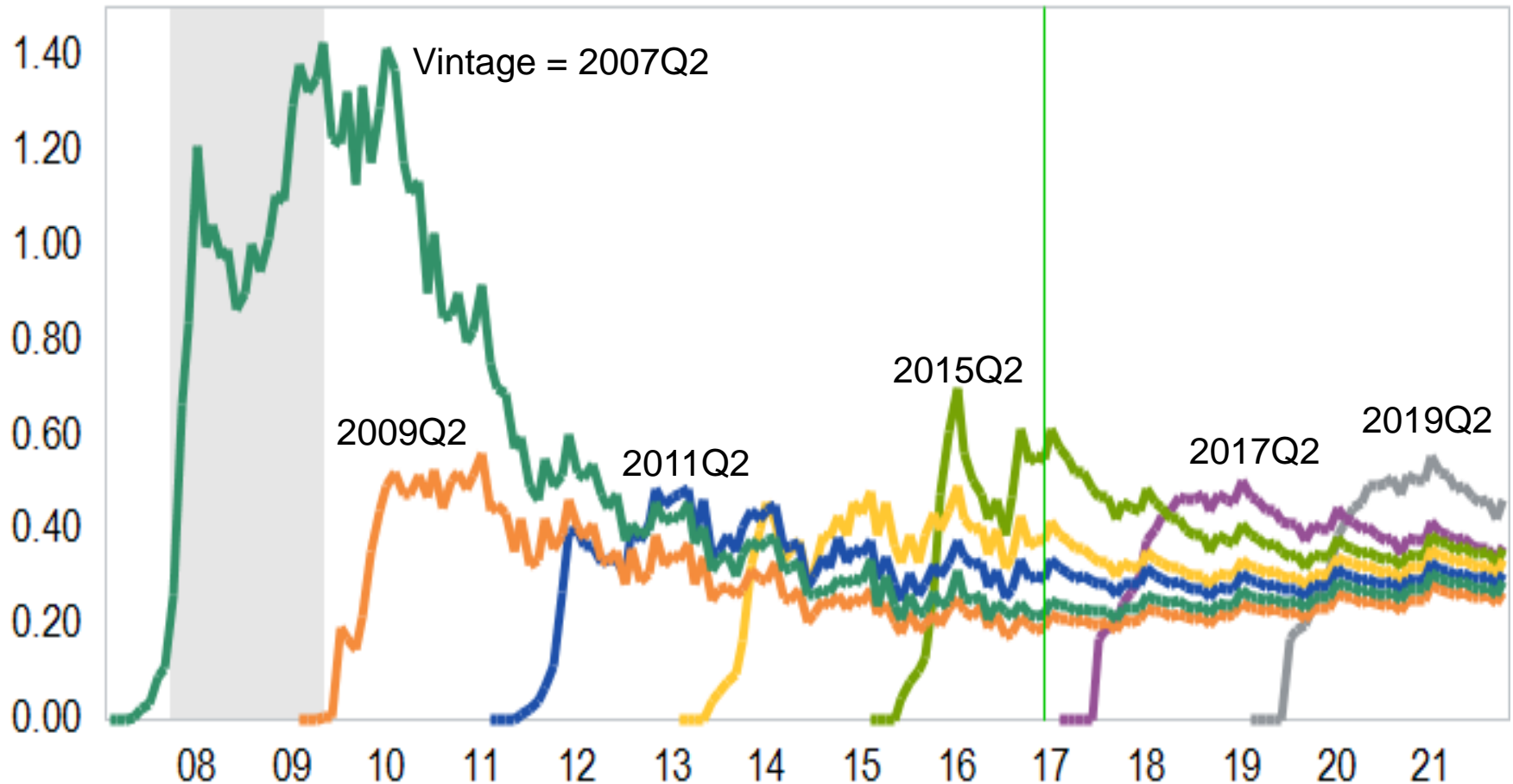
Sources: Equifax, Moody's Analytics

CECL Forecast Look-Up Tables

» Econometric models developed on industry-level data can be applied to economic scenarios.

» Suitable for small portfolios, portfolios without much history or as a benchmark for internally built models.

Product	State	Credit Score	Origination Quarter	Outstanding Balance	PD Rate	LGD Rate	ECL Rate	CECL	
Bankcard	CA	700-719	2009Q2	$100	4%	99%	4.0%	$	4
Bankcard	CA	660-699	2011Q2	$300	6%	95%	5.7%	$	17
Bankcard	CA	660-699	2013Q2	$500	7%	90%	6.3%	$	32
Bankcard	CA	700-719	2015Q2	$200	4%	85%	3.4%	$	7
Bankcard	CA	700-719	2017Q2	$700	5%	95%	4.8%	$	33
Bankcard	CA	700-719	2019Q2	$1,000	6%	95%	5.7%	$	57
Sum				**$2,800**				**$**	**150**

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Case 2: CECL for residential mortgages

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Data

To estimate a model:

1. Historical loan level mortgage data from non-agency securitized transactions

2. Historical whole loan performance data from lender / servicer

LoanID	Period	OriginationDate	Property	OriginalLTV	MortgageType	FICO	Rate	Balance	Status
1	Jan 2010	5/1/2005	S	80	30-Year Fixed	730	6.25	538,235	Current
1	Feb 2010	5/1/2005	S	80	30-Year Fixed	730	6.25	537,735	Current
1	Mar 2010	5/1/2005	S	80	30-Year Fixed	730	6.25	537,235	Current
1	Apr 2010	5/1/2005	S	80	30-Year Fixed	730	6.25	536,735	30DPD
1	May 2010	5/1/2005	S	80	30-Year Fixed	730	6.25	536,235	60DPD
1	Jun 2010	5/1/2005	S	80	30-Year Fixed	730	6.25	535,735	Defaulted
2	Jan 2015	12/10/2014	S	80	30-Year Fixed	634	4.25	300,000	Current
2	Feb 2015	12/10/2014	S	80	30-Year Fixed	634	4.25	299,800	Current
2	Mar 2015	12/10/2014	S	80	30-Year Fixed	634	4.25	299,600	Current
2	Apr 2015	12/10/2014	S	80	30-Year Fixed	634	4.25	299,400	Current
2	May 2015	12/10/2014	S	80	30-Year Fixed	634	4.25	299,200	Current
2	Jun 2015	12/10/2014	S	80	30-Year Fixed	634	4.25	299,000	Prepaid
...	...	...	...	...	...	…	...	...	...

For loss forecasting:

Current whole loan portfolio

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Modeling Framework

Competing Risk Framework

» Survival models – The baseline or nominal hazard rate is a function of the loan age and captures the lifecycle of the loan.

» Defaults and prepayments are mutually exclusive events that compete with each other.

» The default and prepayment models are estimated as a function of the loan and borrower characteristics and macroeconomic factors.

» The models are separately estimated and used in a multi-period setting. The models produce the conditional hazard rate (default or prepayment) at any point in time.

» When running projections in a multi-period setting, the cash flows, principal & interest payments, and losses incorporate defaults as well as prepayments.

» Therefore, the cash flows that are generated automatically account for the expected life of the mortgage even though they are calculated over the contractual life of the mortgage.

Loan level models in a competing risk framework

Panel logit model linking default and prepayment probabilities to loan-level and borrower-level attributes and macro-economic variables
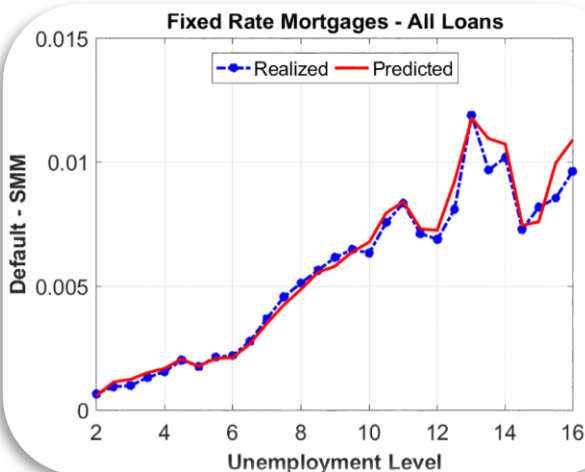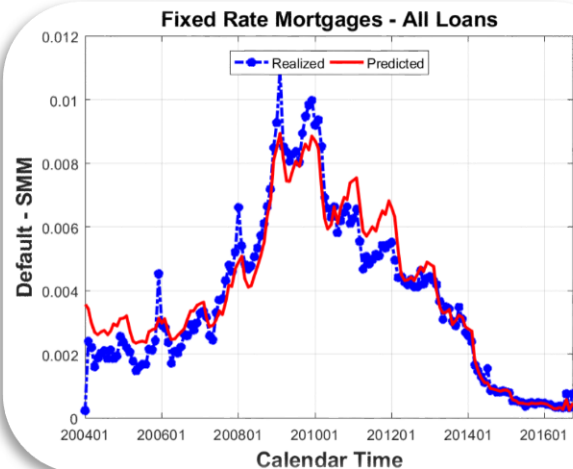
Model Coefficients

Constant	0.2378
FICO	-0.1234
UpdatedCLTV	0.2519
Unemployment	0.7856
Property_SF	-0.1947
...	
Purpose_P	-0.0829
...	
Occupancy_P	0.0045
...	
FullDoc	0.0000
PartialDoc	0.5219
NoDoc	1.3675
...	
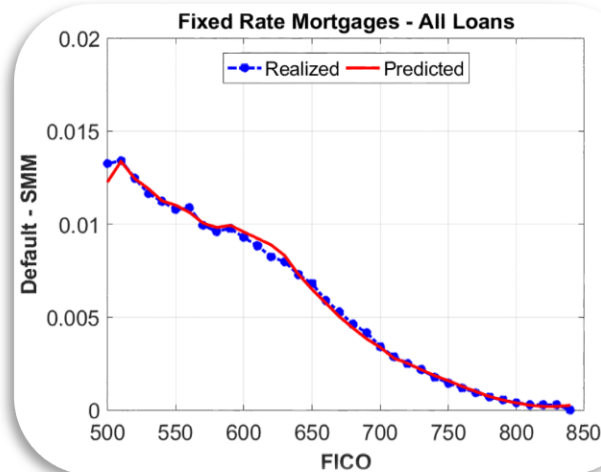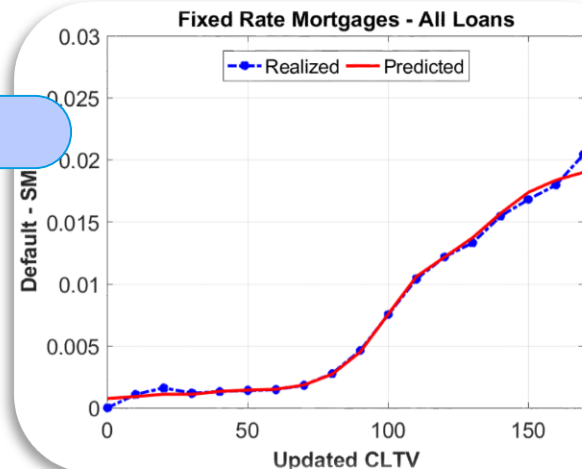
Projecting Cash Flows and Calculating Expected Loss

Rate Resetting for Adjustable Rate Mortgages. Consider reset terms, margin, underlying index, and reset frequency

Amortization. Consider loan rate, maturity. Calculate scheduled payments.

Credit Models – default and prepayment probabilities, Loss Given Default (LGD)

Expected cash flows – Principal, Interest, Loss, and Recovery

Discount cash flows to obtain present value of expected loss

Effective Date

Discount
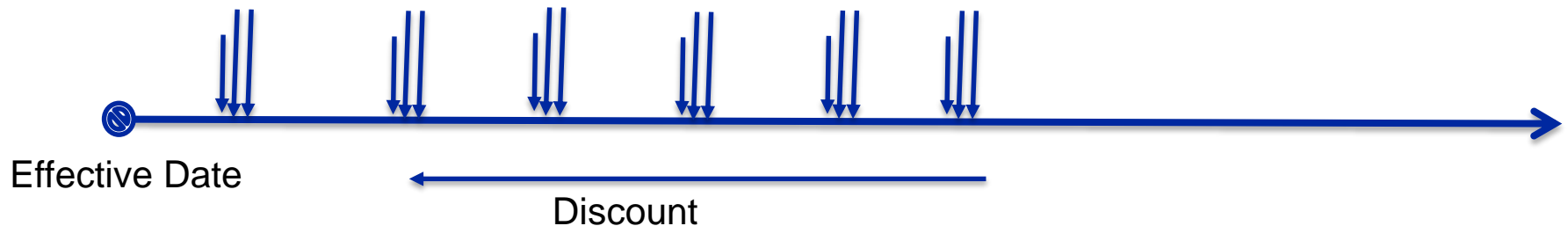
Generating Cash Flows
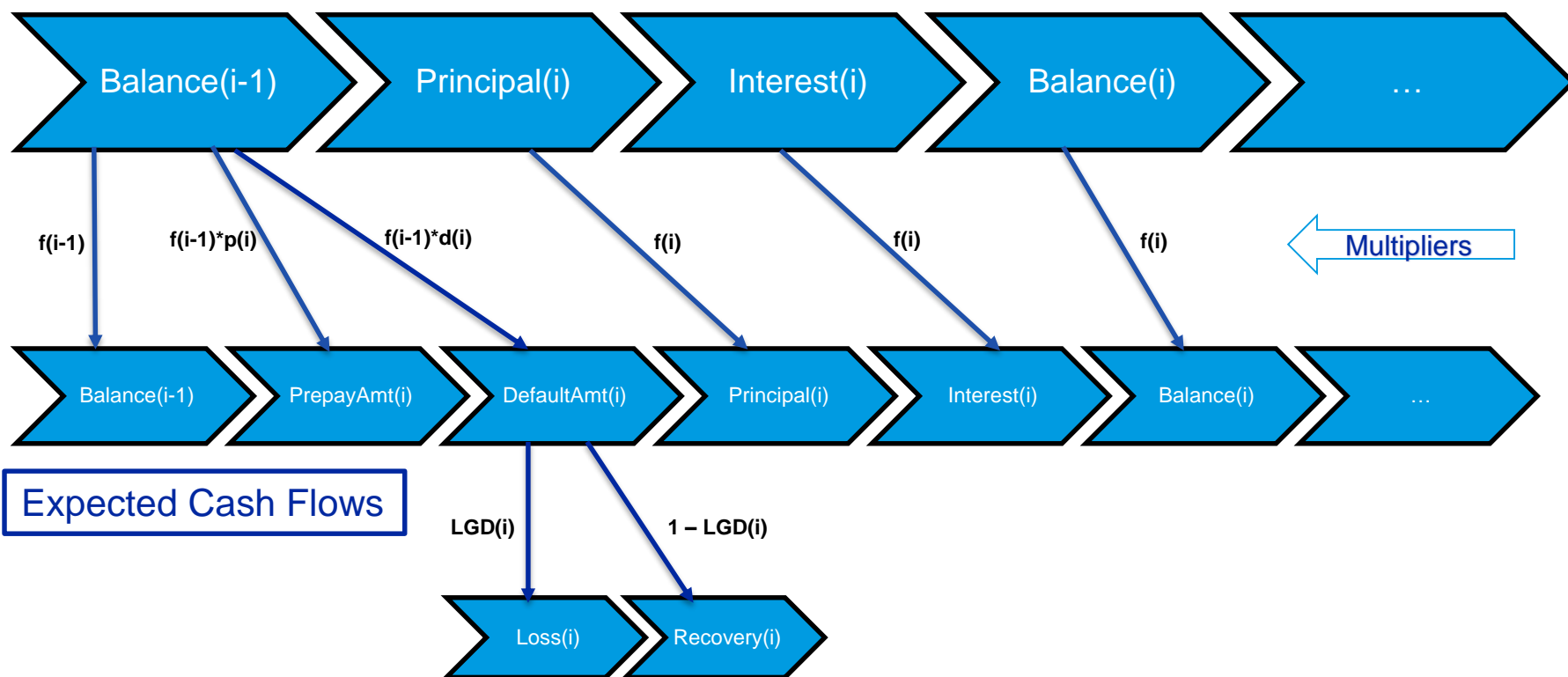
d(i) = Default probability, p(i) = Prepayment probability, LGD(i) = Loss Given Default
f(i) = Survival probability after period i
f(i) = f(i-1) * (1 − p(i) − d(i))

Data Challenge: Calibrating to short time history

If the model is to be calibrated to data with a short time history, we retain sensitivities to macro variables and estimate other coefficients

Client Data - All Loans

Fixed Rate Mortgages - All Loans
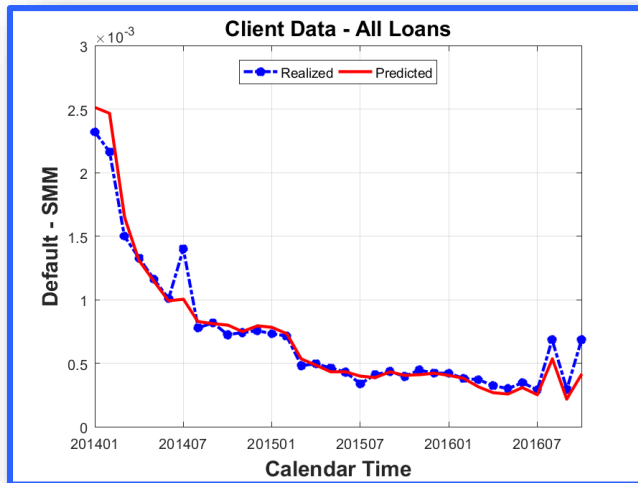
Model Coefficients

Constant	0.1127
FICO	-0.2912
UpdatedCLTV	0.2519
Unemployment	0.7856
Property_SF	-0.06
...	
Purpose_P	-0.1
...	
Occupancy_P	0.0555
...	
FullDoc	0.0000
PartialDoc	0.6345
NoDoc	1.123
...	

Fixed Rate Mortgages - All Loans

Client Data - All Loans

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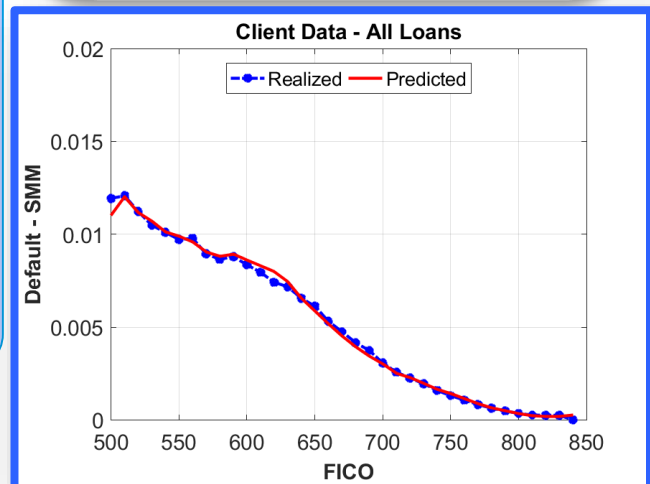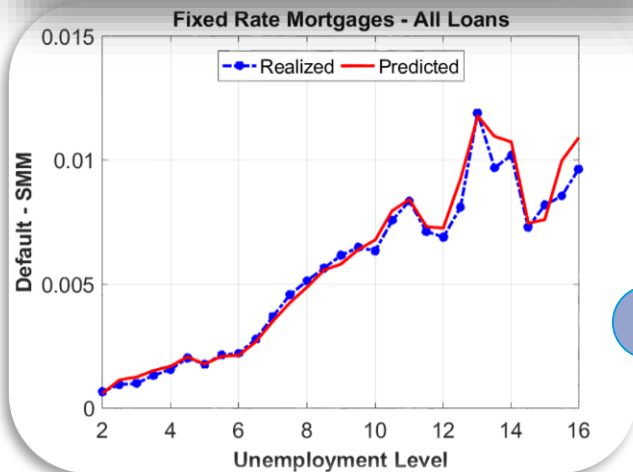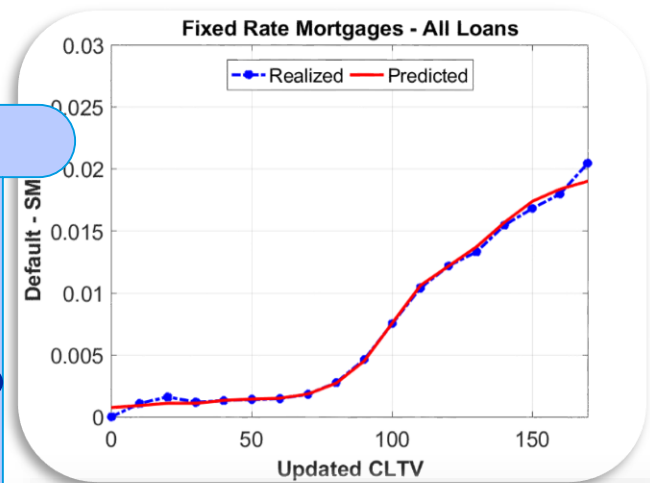
Other Data Challenges

» Limited number of fields: For example, historical performance data is available, but borrower documentation, property type, and a few other fields are missing.

– Remedy: Set the coefficients of those variables to zero and re-estimate the other coefficients. The other coefficients will adjust to calibrate the model to the available data.

» No loan level historical data: For example, historical performance is known for different FICO, LTV, and vintage buckets, but no loan level data to execute the loan level models.

– Remedy: Construct "replines" or representative loans for each bucket and calibrate the model to those buckets

» Limited loan level data for model execution or forecasting: For example, reliable data for occupancy and loan purpose is not available and lifetime losses have to be forecast.

– Remedy: Use typical values of these variables to account for the missing data.

Retail Credit Challenges for CECL

» *Number of elements to consider when bringing **macroeconomic drivers** into forecasting models. **Scenario selection** is one.*

» ***Lifetime length determination** straight-forward for non-revolving credit, but the approach for revolving credit requires some thought.*

» *Can **adapt existing loss forecasting, Basel, or stress testing models** for CECL. Alternatively, a forecasting approach can provide all metrics required for CECL impairment.*

» ***Custom** or **industry-wide, "off-the-shelf" models** are options based on portfolio size and data availability. Cohort- and loan-level approaches are available.*

» ***Benchmarking** results is a best practice.*

» ***Process is evolving**. Accountants and regulators will weigh in and clarify rules.*

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