MOODY'S ANALYTICS

Stress Testing Webinar Series: Macroeconomic Conditional Loss Forecasting

Originally presented and recorded on October 29, 2013

Presented by: Moody's Analytics

Agenda

1. Introductions
2. Overview
3. Consumer Loss Modeling
4. Structured Product Loss Modeling
5. Commercial/Wholesale Loss Modeling (non-public)
6. Commercial/Wholesale Loss Modeling (public)
7. Next Webinar: PPNR Models
8. Questions

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Introductions

Presenters for Today's Webinar

Thomas Day, Senior Director, Regulatory and Risk Solutions
Thomas works to solve difficult stress testing, capital planning, and risk management problems across complex portfolios and product sets for financial services institutions worldwide. His areas of focus include CCAR/DFA stress testing, pre-provision net revenue (PPNR) calculations, systems and methodologies, advanced liquidity risk quantification and reporting, capital planning, performance and balance sheet management.

Cristian de Ritis, PhD, Senior Director, Consumer Credit Analytics
Cristian leads a team of economists focused on consumer credit modeling and analysis for banks and other financial institutions. He provides regular commentary to clients and the media on the state of consumer credit markets and small business.

Luis Amador, Senior Director, Valuations & Consulting
Luis leads the Structured Finance Valuations and Advisory Team at Moody's Analytics. His team is responsible for analyzing secured products globally and develops risk and regulatory software solutions. His team's clients include banks, asset managers and insurance companies seeking credit analysis and market valuations for structured portfolios, including ABS, CLOs, TruPs CDOs, RMBS and CMBS securities and private deals.

Presenters for Today's Webinar

Chris Henkel, Director, Enterprise Risk Solutions
Chris leads risk management engagements throughout North America. He has extensive experience in commercial credit and financial analysis, portfolio management, asset quality, loan loss reserve methodologies, credit administration, process redesign, and credit risk modeling. He has served as a credit risk instructor and is a frequent lecturer at industry conferences.

Danielle H. Ferry, PhD, Associate Director, Capital Markets Research Group
Danielle leads the development of Stressed EDF measures, a corporate credit risk metric providing probability of default forecasts conditioned on varying macroeconomic scenarios. Her experience in helping financial institutions manage risk stemming from macroeconomic factors includes the full-cycle development of numerous proprietary quantitative models.

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Overview

Stress-Testing Complexities

- The stress-testing exercise is one of the biggest challenges undertaken by the industry and regulatory community
  - Impacts numerous business processes and functional areas
  - Achieving “best-practice” remains a work in progress

- The national policy objective – increase the loss absorbing capacity of banks for:
  - Losses under severe stress ➔ Higher capital, and higher quality capital
  - Ensure a resilient pool of unencumbered liquidity to reduce over-reliance on the “lender of last resort”

- The objective of the banks: Satisfy the regulators, but also ensure that any firm infrastructure and/or reporting investments improve business processes and create firm-value

Stress-Testing Complexities Create Many Questions

- Modeling losses under given economic scenarios is one of the most difficult aspects of the stress-testing exercise
  - Do you have enough reference default data by the right dimension?
    - Industry
    - Geography
    - Product type
  - Are you conditioning the models on the most important economic drivers of risk?
  - Are the economic variables selected at the right level of granularity?
    - National v. Local markets?
  - Are the models validated? Do you have required resources?
  - Do you have challenger approaches that help you “triangulate” your loss estimates?
- How do you translate loss estimates to charge-offs and the ALLL?
- How do you reduce net interest income for growth in non-performing loans?

Our Objectives Today?

- Given the criticality of loss estimation, and the need for different models by asset class, we will cover loss estimation for:
  - Retail Exposures (non-mortgage)
  - Structured Portfolios
  - Wholesale C&I (non-public)
  - Wholesale (public)

- During future webinars, we may revisit other asset classes:
  - Mortgage
  - CRE
  - Municipal

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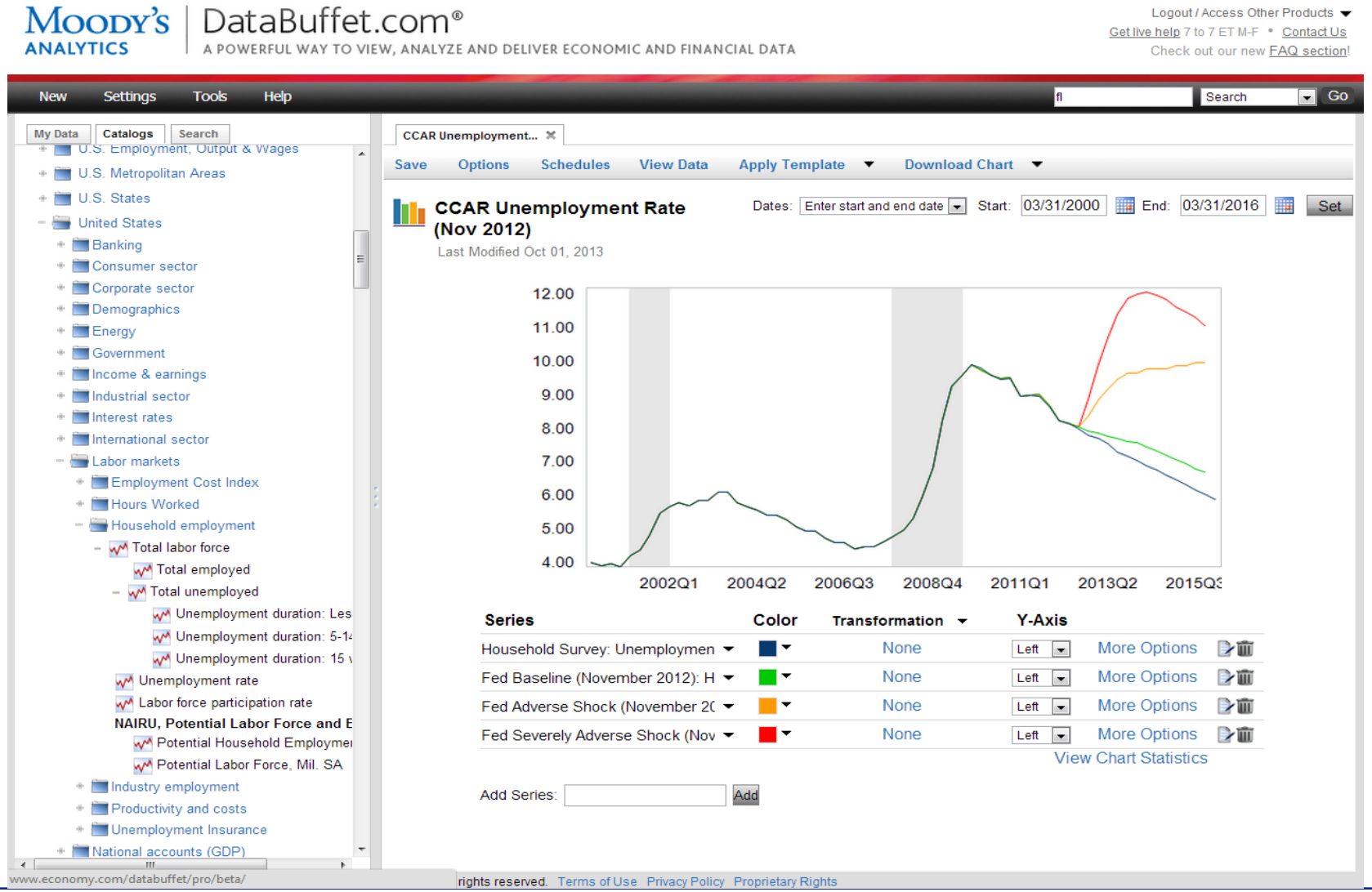
Macroeconomic Conditional Loss Forecasting of Retail Exposures

Best Practices in Consumer Credit Risk Modeling

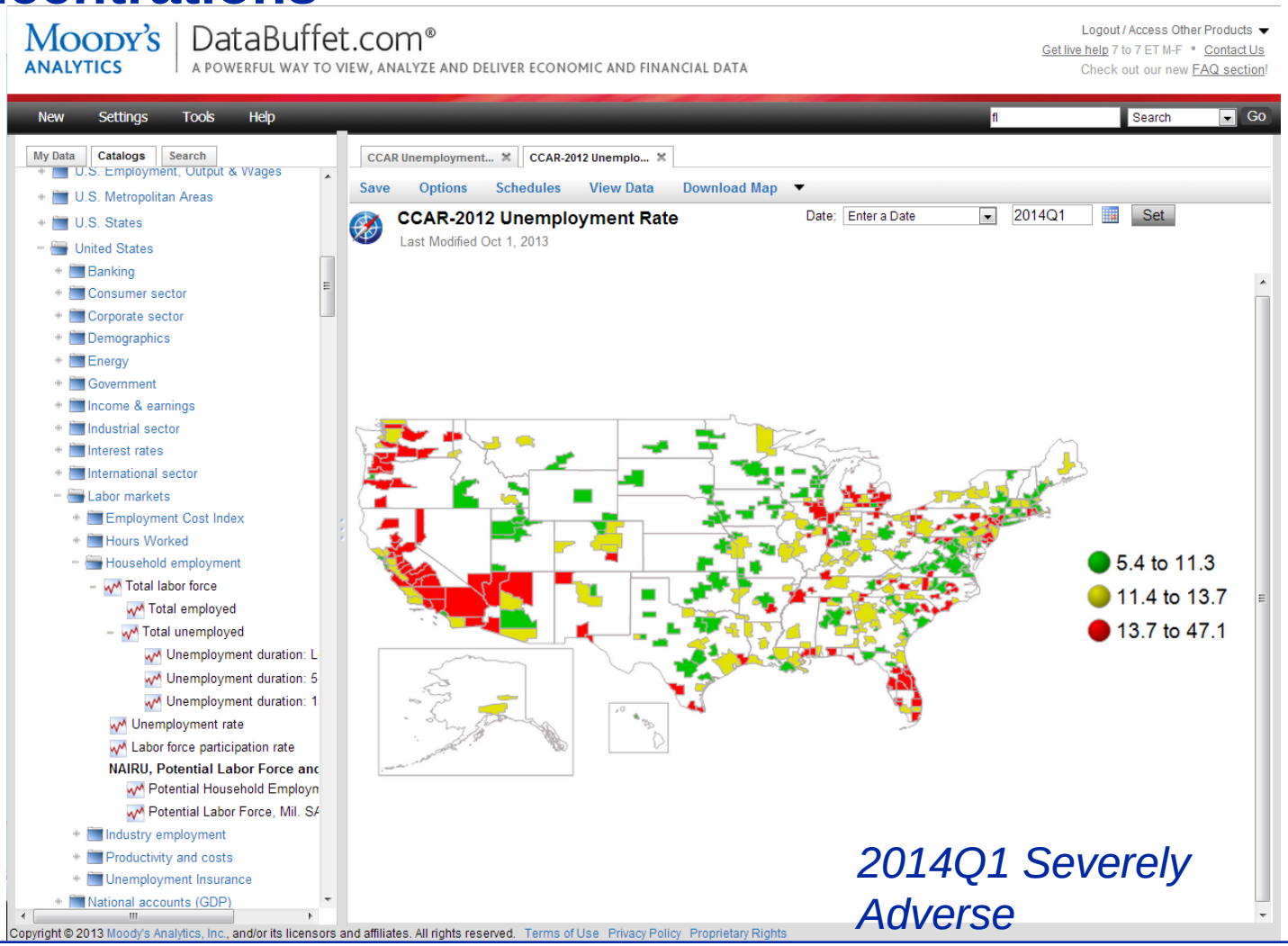
- Retail credit risk models for regulatory stress testing need to be **sound**, **transparent** and well **understood** by banks
- Estimate losses as a function of the probability of default (PD), loss given default (LGD) and exposure at default (EAD)

  EL = EAD * PD * LGD
- Variety of models are available
  - Panel, competing risk, transition matrices
  - Loan or segment level models
  - Choice depends on data availability and objectives
- Documentation is critical
  - Validation groups focus on each model's conceptual underpinnings.
  - Validators review modeling decisions and assumptions in addition to forecast results

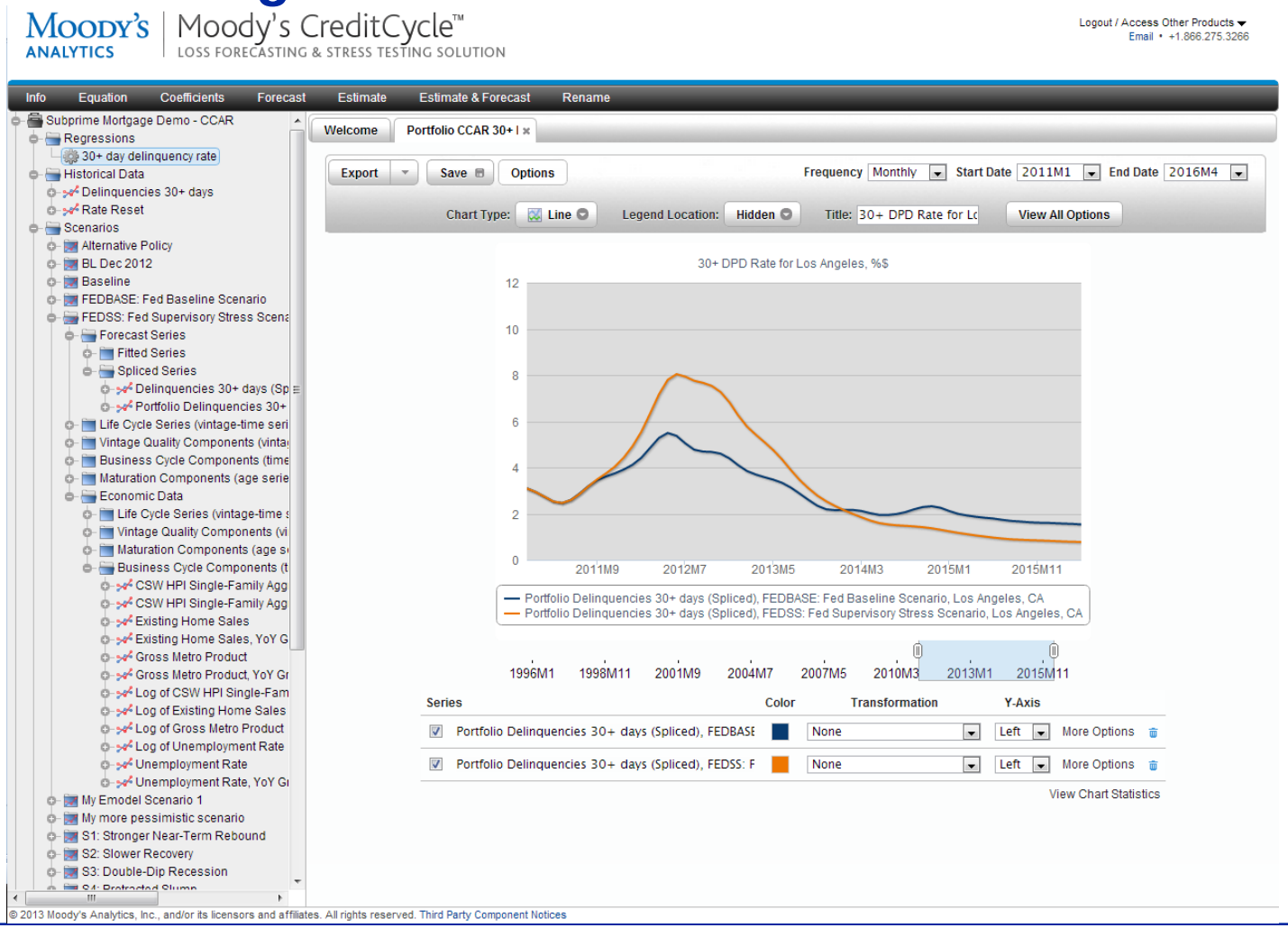
Macroeconomics Matter… Models Should Consider Broader Trends, Feedback Loops, etc.



But Local Economics Can Matter *Even More…* Idiosyncratic Scenarios Stress Geographic or Industry Concentrations



Economic Sensitivity Impacts Choice of Modeling Framework… Consider Economic Dynamics and Impact of Future Originations



The Fed Provides 14 CCAR Variables at the US Level – but Other Variables for Credit Models May Be Necessary

- Employment
- Unemployment Insurance claims
- Bankruptcy filings by chapter
- Consumer credit debt outstanding (revolving and non-revolving)
- Used car prices
- Sales volumes (car, truck, housing, retail)
- Oil prices
- Prime rate, LIBOR, other rate indices
- ABA/MBA delinquency rates
- Personal savings rate
- Debt service and financial obligations ratios
- Credit Forecast delinquency rates by product, vintage, geo, score
- Regionality of house prices, employment, etc. is critical

Support Forecasts with External Data

- Champion/challenger models give a broader view
  - Over-reliance on single model technologies during last recession
  - Leverage strengths of multiple approaches
  - Fully transparent, back-tested and documented econometric loss forecasting models customized to specific portfolios
- Benchmarking
  - Several sources of industry data exist across individual consumer credit products
    - Credit bureaus, consortiums, ABS/MBS securities data
    - Credit variables including volume, delinquencies, default, prepayment, etc.
  - Industry data can fill in portfolio data deficiencies for modeling
- Size the approach to meet the needs of the institution
  - Banks of all sizes will need some sort of stress testing
  - Need to balance model complexity with institutional plans

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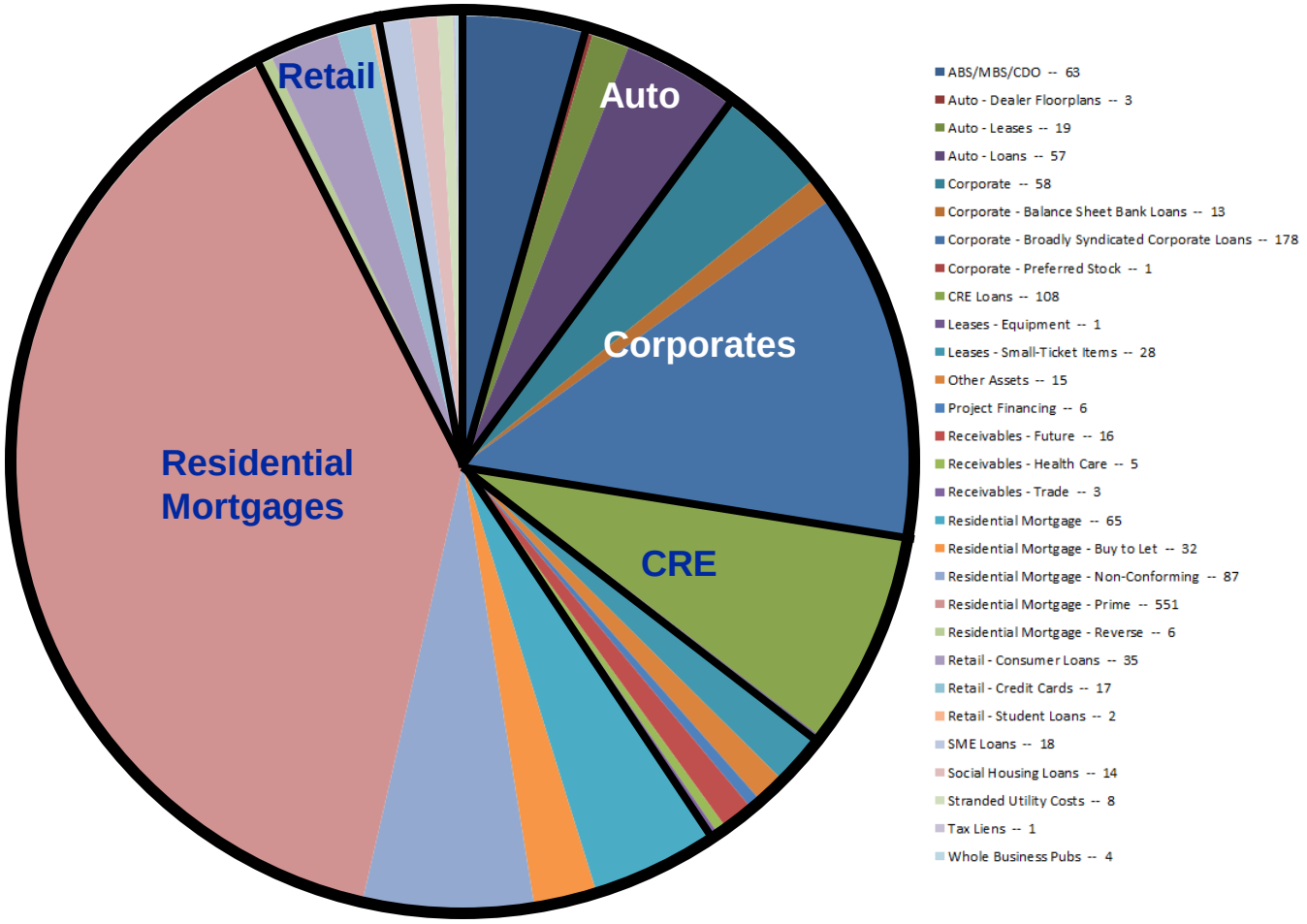
Macroeconomic Conditional Loss Forecasting of Structured Portfolios

Securitization: A Microcosm (and, sometimes, Macrocosm) of Institutional Balance Sheets

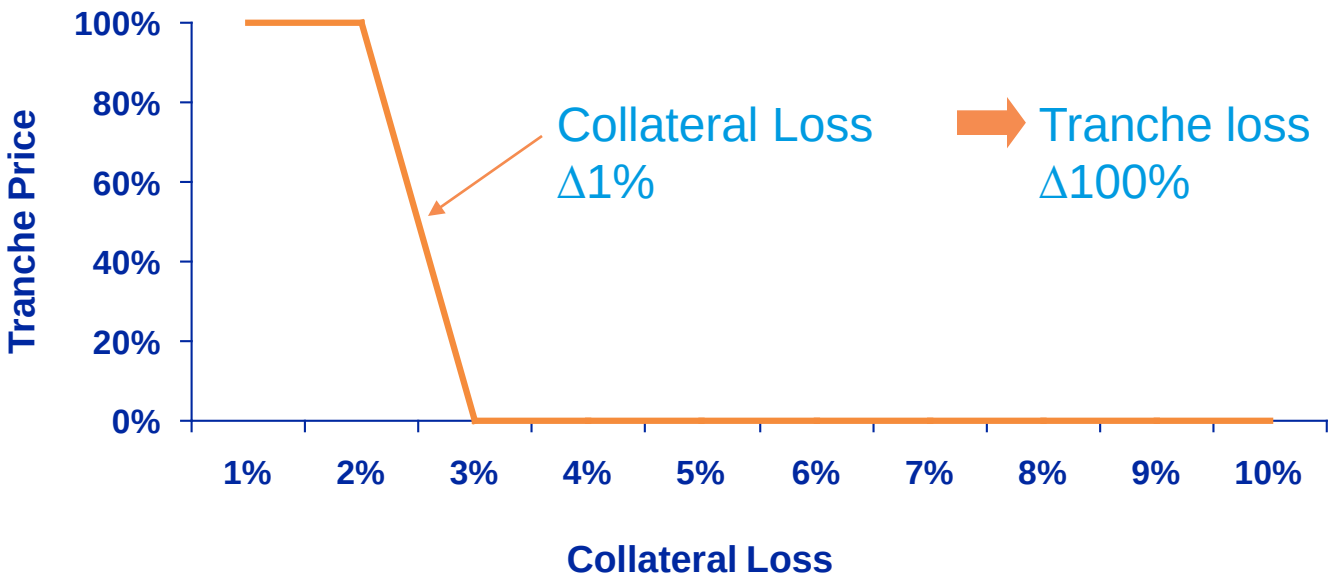


Challenges in Stress Testing Structured Instruments

- Integration
  - Full Integration of all the data and models needed for Structured Finance is the biggest challenge
  - Requires multiple models and dedicated development resources
- Coverage
  - Credit and Cashflow models for certain asset classes may not exist
- Data
  - Requires addition of supplementary data, cleansing and validation
  - Loan Level not available for all asset classes
- Consistency
  - Models developed by different companies, with varying academic approaches, are inherently different
- Transparency
  - Higher level of documentation requirements for all parts of the process - (bank has to “own” the models)
  - Explaining strength of macro variables, non intuitive results, all analytic assumptions
  - Ongoing model validation to ensure model is applicable in new macro/credit environment

Scenario Outcomes often seem Counterintuitive

- Static approaches can expose “thin tranche” and “cliff” effects
  - Seemingly innocuous changes in assumptions (e.g. default and prepayment vectors) can drive significant movements in cash flows
  - Price can jump higher in more Adverse scenarios vs. Baseline
  - Main cause: overcollateralization-based triggers cause cash lock-up
  - Magnitude of the effects varies depending on position in the capital structure

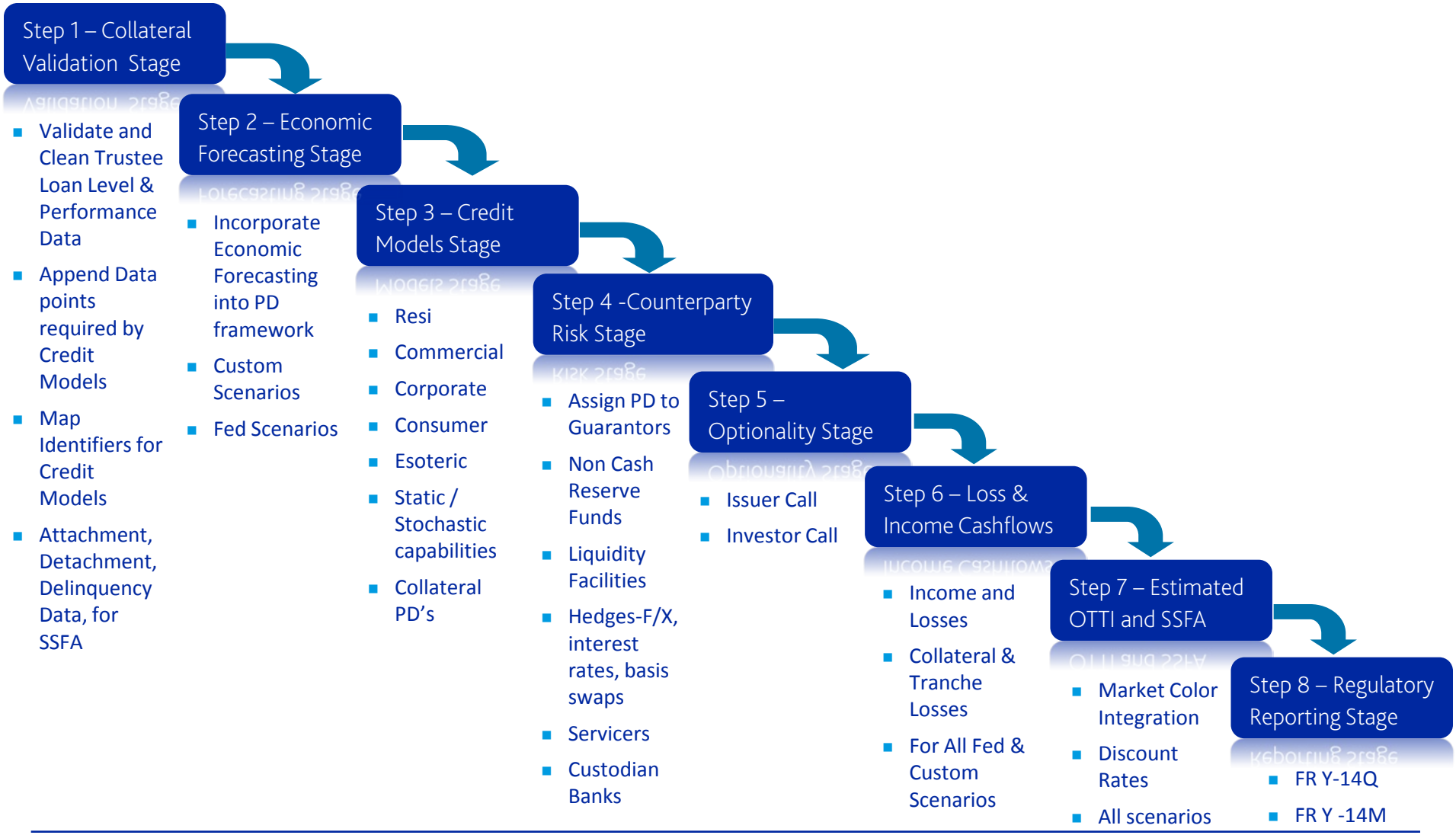


Our Approach

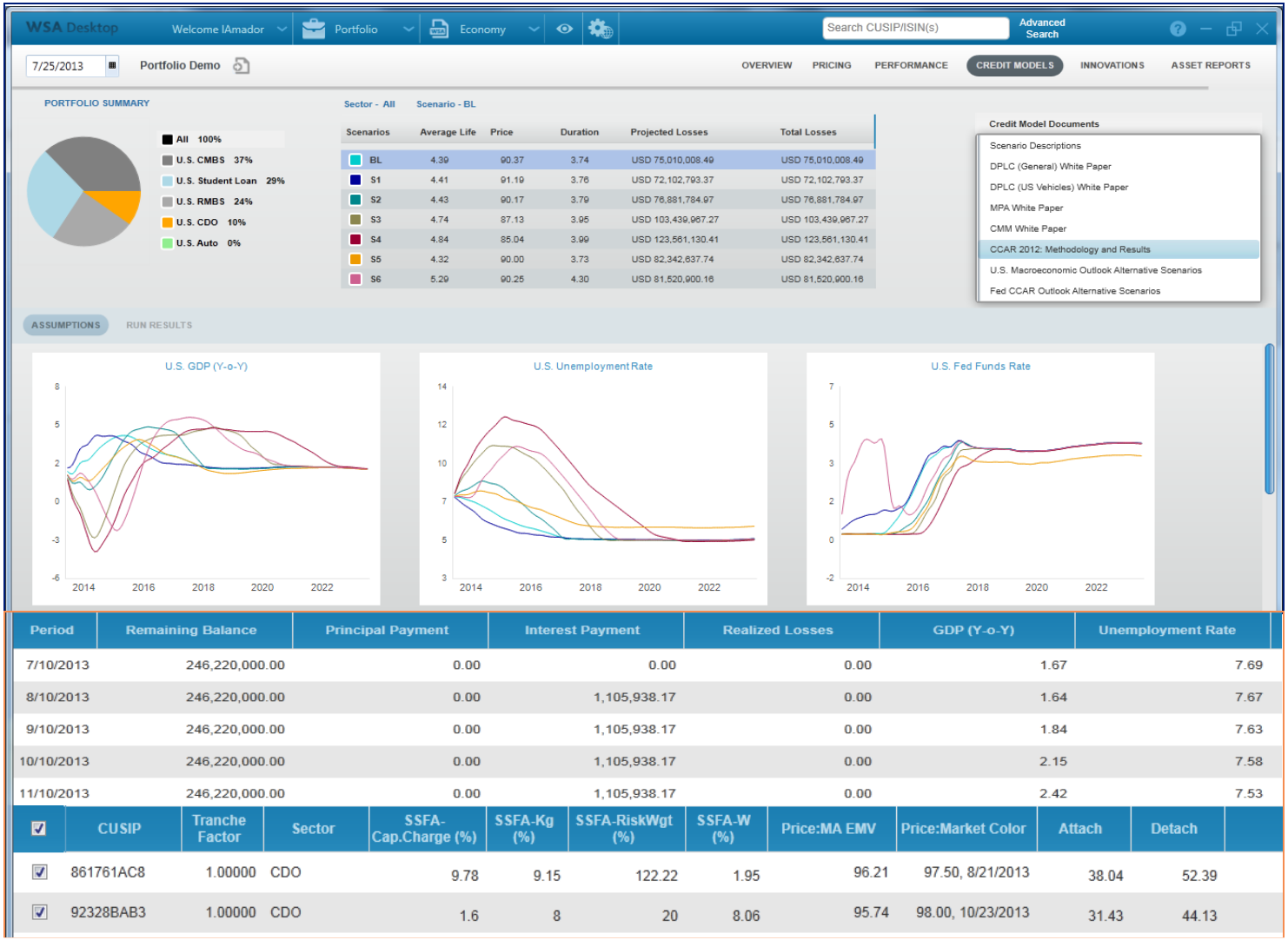
Fully Integrated Solution for Stress Testing & Risk Management

- **Macro Economic Scenarios**
  - Fed Scenarios, Moody's Analytics Scenarios, Custom Scenarios
- **Credit models**
  - Retail, Consumer, Residential Mortgage
  - Commercial, Corporate
- **Cashflow Libraries**
  - Full Global Waterfall Coverage
  - Loan and Pool Level Data
- **Portfolio Risk Management Software**
  - WSADesktop
- **Regulatory and Risk Management Metrics**
  - Estimated PD's, SSFA, OTTI, Interest Rate Sensitivities Cashflows
- **API's**
  - Integrate all content programmatically
- **Advisory & Valuations**
  - "Moody's Analytics Opinion"
  - Help prepare financial entity for regulatory review

Stress Testing Structured Finance Requires Many Steps



Analytical tool for stress testing structured portfolios



Period	Remaining Balance	Principal Payment	Interest Payment	Realized Losses	GDP (Y-o-Y)	Unemployment Rate
7/10/2013	246,220,000.00	0.00	0.00	0.00	1.67	7.69
8/10/2013	246,220,000.00	0.00	1,105,938.17	0.00	1.64	7.67
9/10/2013	246,220,000.00	0.00	1,105,938.17	0.00	1.84	7.63
10/10/2013	246,220,000.00	0.00	1,105,938.17	0.00	2.15	7.58
11/10/2013	246,220,000.00	0.00	1,105,938.17	0.00	2.42	7.53

☑	CUSIP	Tranche Factor	Sector	SSFA-Cap.Charge (%)	SSFA-Kg (%)	SSFA-RiskWgt (%)	SSFA-W (%)	Price:MA EMV	Price:Market Color	Attach	Detach
☑	861761AC8	1.00000	CDO	9.78	9.15	122.22	1.95	96.21	97.50, 8/21/2013	38.04	52.39
☑	92328BAB3	1.00000	CDO	1.6	8	20	8.06	95.74	98.00, 10/23/2013	31.43	44.13

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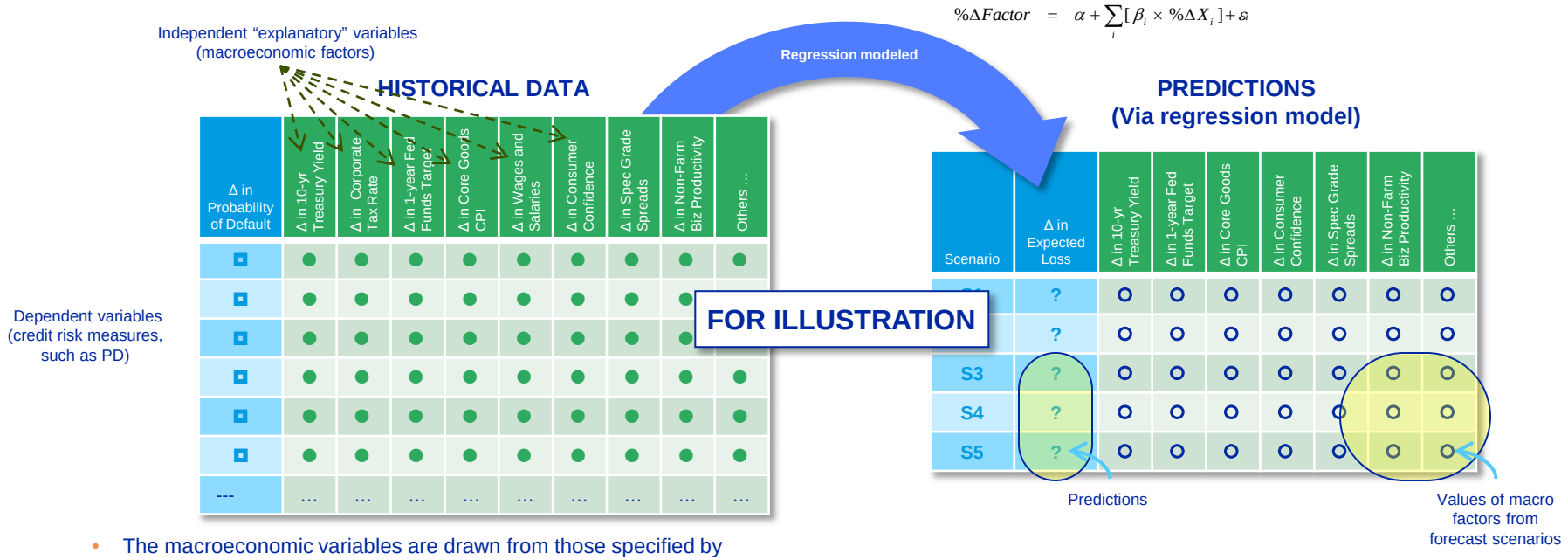
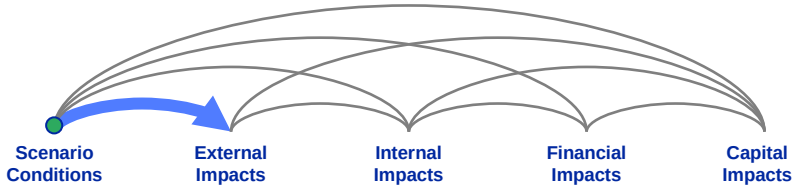
Macroeconomic Conditional Loss Forecasting of Wholesale C&I (Non-Public) Portfolios

Our Stress Testing Framework Links Macroeconomic Factors to Credit Risk Measures – and Charge Offs



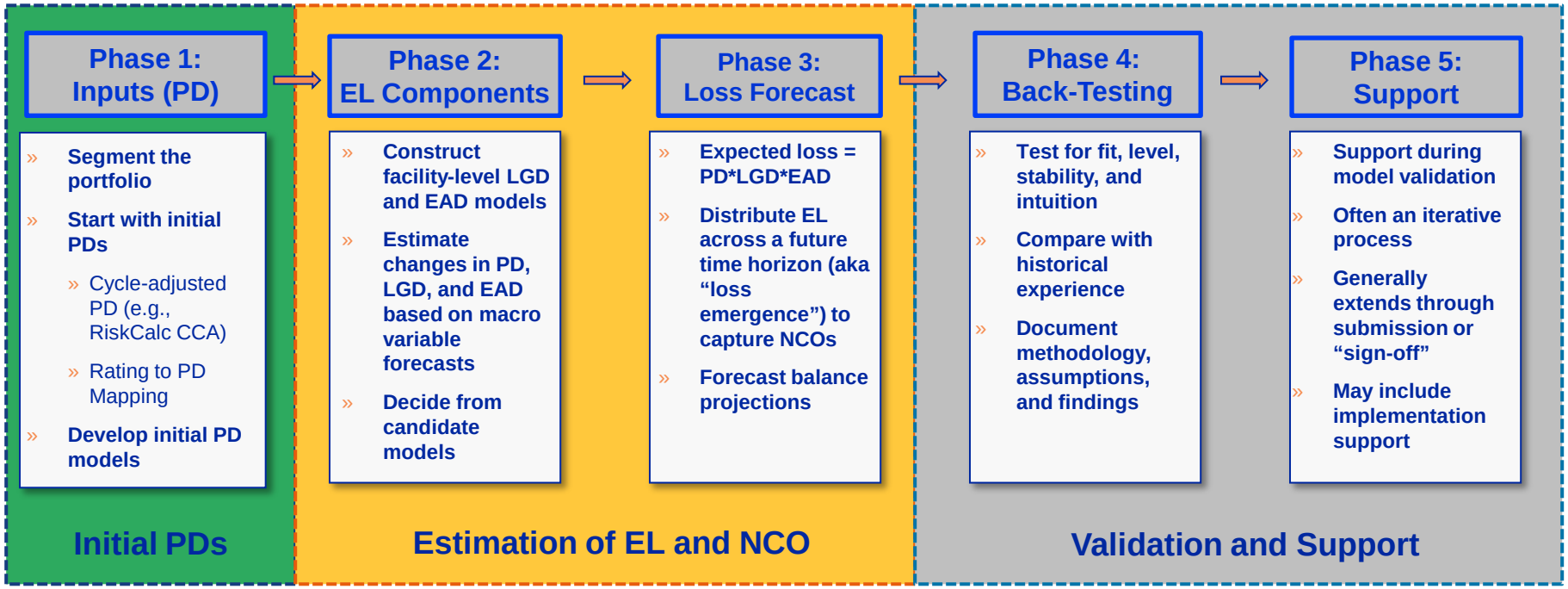
- The macroeconomic variables are drawn from those specified by the Federal Reserve in CCAR process. *Moody's and the client will jointly determine the macro-variables to be considered*
- **In advance of modeling, segmentation is performed for appropriate granularity (e.g., geography, industry, etc.)**
- **The PD, LGD, and EAD models are used to calculate the EL – and translate those to charge-offs at the segment level**
- The output will also be used to calculate rating transitions and future portfolio balances



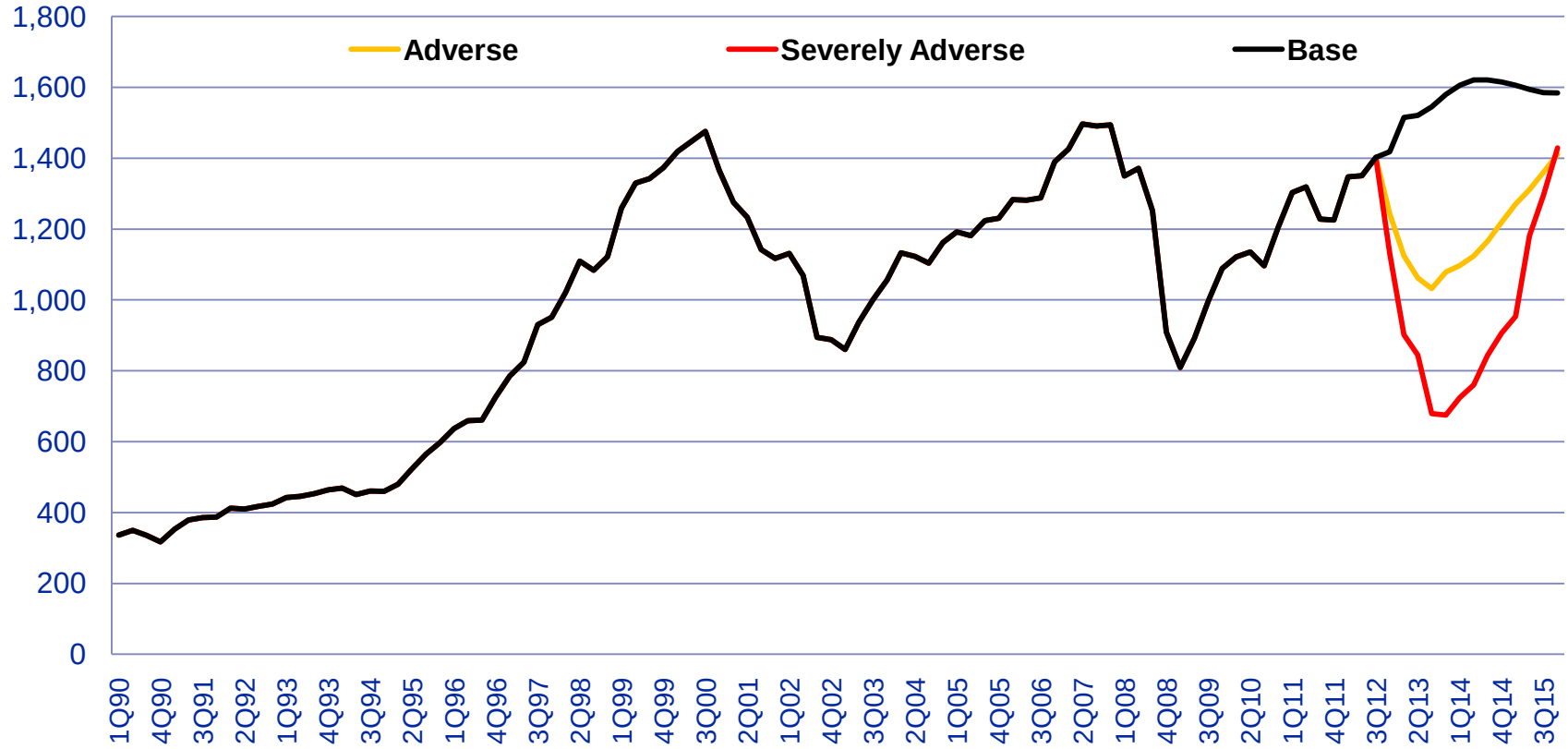
Our goal is to translate the relationship between scenario conditions and their impact

A typical stress testing engagement tends to follow a five-phase process

Phases of a Typical Engagement

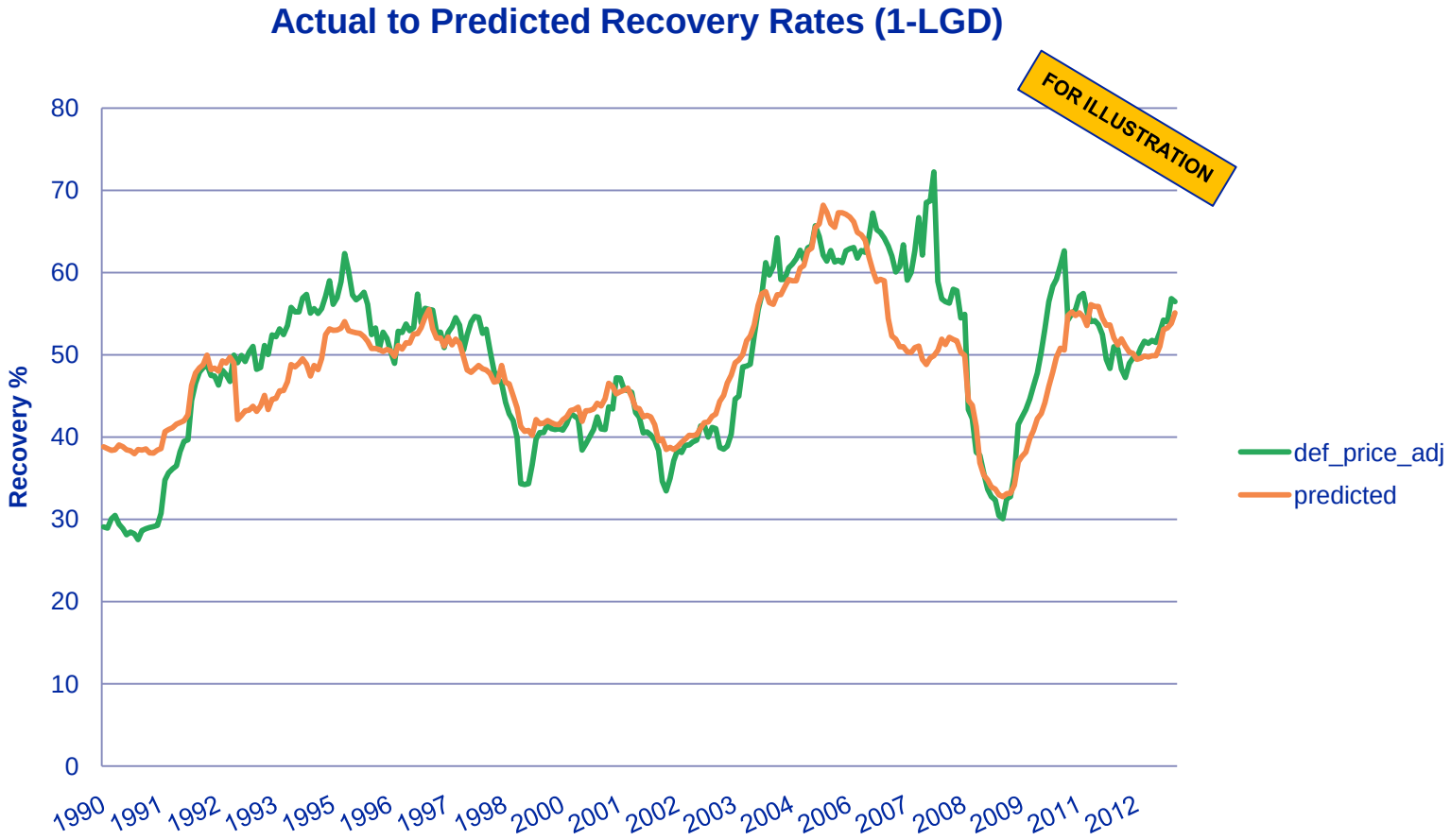


Time Series for the S&P 500 Index



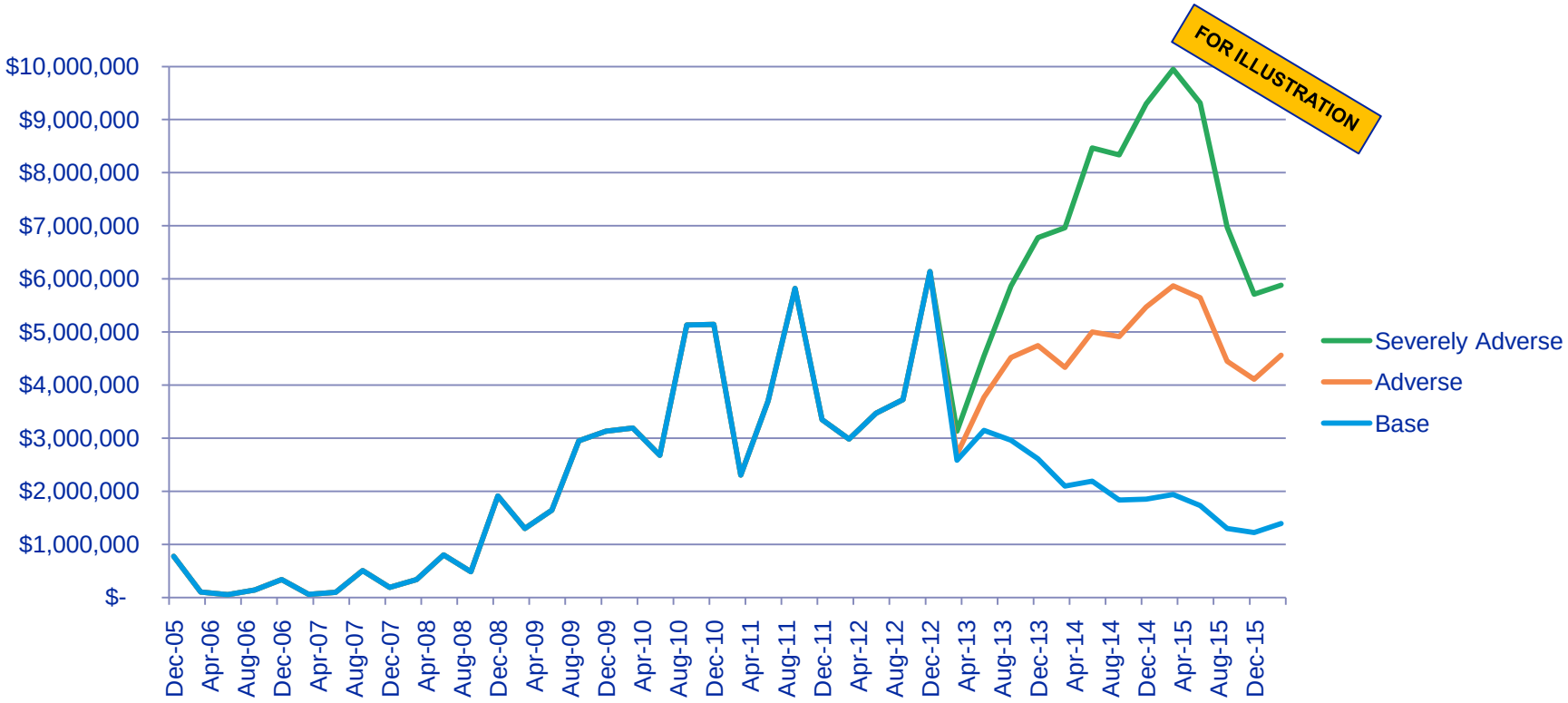
Projected period: 2Q13 to 4Q15

Comparing a Time Series of Actual to Predicted Performance is a Critical Validation Exercise



Recovery % = 1 – LGD %; e.g., 70% = 1 – 30%

Combined Framework: Time Series Expected Loss Projection (dollar value)



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Macroeconomic Conditional Loss Forecasting of Wholesale C&I (Public) Portfolios

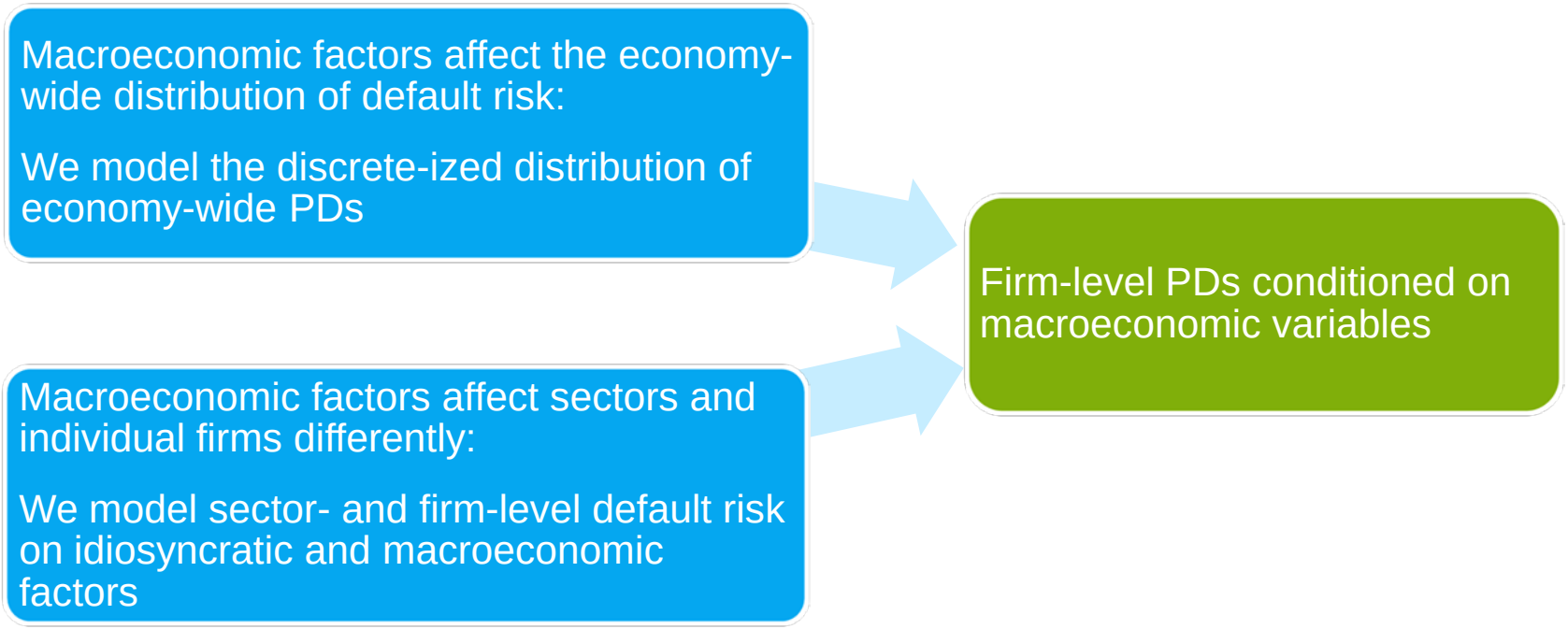
A Structural Model Relating PDs to Macroeconomic Scenarios Has the Advantage of Highly Intuitive Results

Low GDP Growth → High PD

High GDP Growth → Low PD

Loan Level Model or Pool Level Model? How About Both?

Moody's Analytics' Stressed EDF model consists of two sub-models: one to capture the economy-wide effects and another to capture sector- and firm-specific effects



Choice of Macroeconomic Variables Should Be Based On Theoretical Groundings Specific to the Asset Class

MACROECONOMIC

Driver	North America	Western Europe
Real GDP growth	X	X
Real consumption growth		X
Real investment growth		X
Real export growth	X	X
Unemployment rate	X	X
CPI inflation rate	X	X
PPI inflation rate	X	X
Corporate profit growth	X	

FINANCIAL

Driver	North America	Western Europe
Stock index growth	X	X
Yield curve	X	X
Short-term interest rate		X
Baa spread	X	X
Ted spread	X	X
S&P 500 volatility		X

* Wherever possible, firms are matched up with macroeconomic or financial data specific to their country of incorporation. The W. Europe models also include US real GDP growth, to proxy for global growth. In the aggregate-level models, we use weighted averages of the constituent countries' macro drivers, where the weights are based on each country's representation in the Public Firm EDF universe. The yield curve is defined as the long-term less the short-term government bond rate. The Baa spread is defined as the Moody's Baa yield less the 10-year Treasury yield. The Ted spread is defined as 3-month LIBOR less the 3-month T-bill yield. The 30-day moving average of the standard deviation of the percent change in the S&P 500 is used to measure volatility.

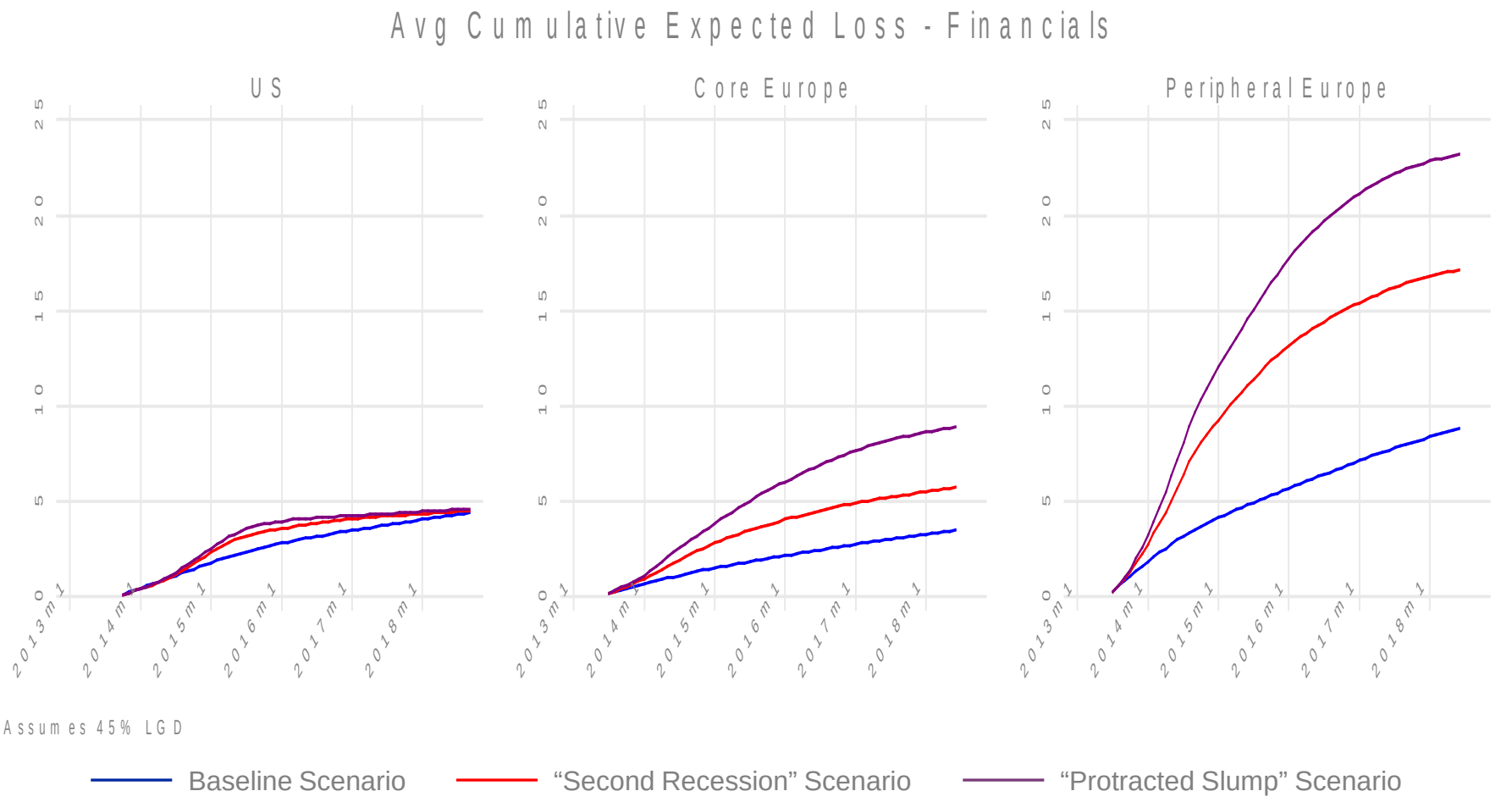
In a CCAR-Style Stress Test, PDs Are Often the Most Difficult Piece of the Puzzle

$$E[Loss] = PD \times LGD \times EAD$$

40% / 45% / 50% $1

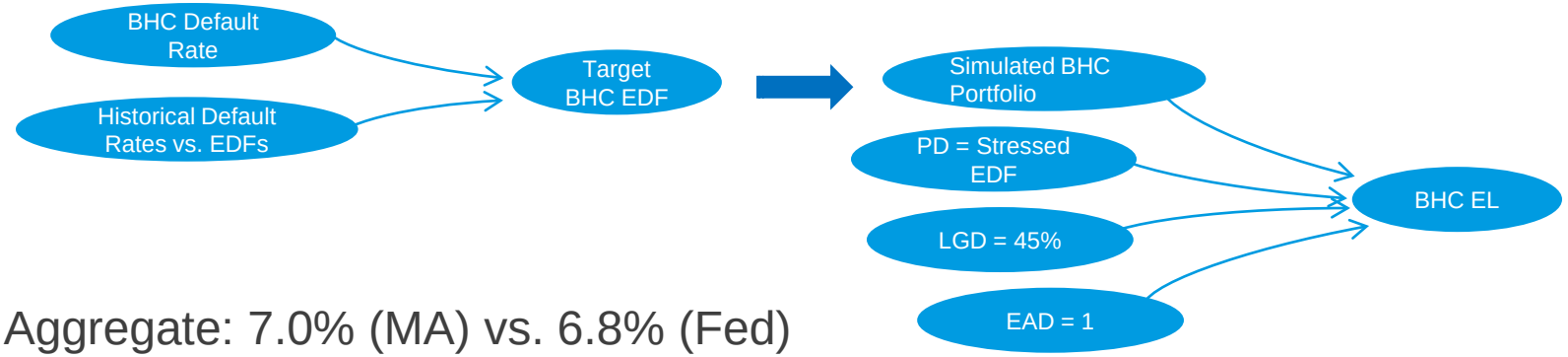
$$CEDF_t = 1 - \left[\left(1 - \frac{SEDF_t}{100}\right)^{1/12} \left(1 - \frac{SEDF_{t+1}}{100}\right)^{1/12} \cdots \left(1 - \frac{SEDF_{t+24}}{100}\right)^{1/12} \right]$$

Hypothetical Stress Test of Financial C&I Exposures

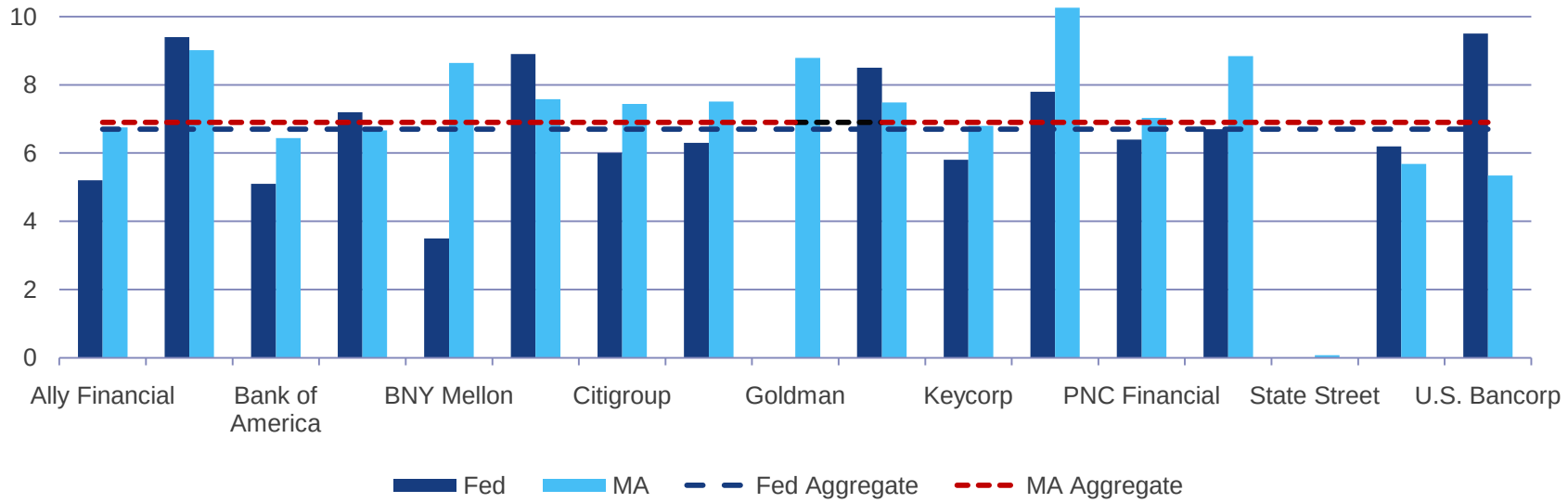


Source: Moody's Analytics

Simulated Stress Test for C&I Loans at DFAST/CCAR Banks



Aggregate: 7.0% (MA) vs. 6.8% (Fed)



Source: Board of Governors of the Federal Reserve; Moody's Analytics
Notes: Not displayed is the Fed's estimate of 49.8% for The Goldman Sachs Group.

Summary

- There are many difficult choices and practical limitations when building a conditional expected loss model
- When modeling post-stress PDs for public C&I exposures, we take a unique and highly intuitive approach that explicitly captures both economy-wide, sector level, and firm level effects of changes in macroeconomic variables
- The model is flexible enough to accommodate any macroeconomic scenario, including the Fed's supervisory scenarios and user-defined scenarios
- As the results of our 2012 & 2013 CCAR simulations for C&I loans show, this approach produces stressed PDs that are well-suited for CCAR-style stress tests, whether used as a primary or challenger/benchmark model

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Next Webinar

Moody's Analytics Stress Testing Webinar Series

Macroeconomic Conditional PPNR Forecasting

January 28, 2014 at 12:00pm EST

Join Thomas Day and other Moody's Analytics experts for a webinar covering:

- The primary challenges confronting banks when forecasting macroeconomic conditional pre-provision net revenue (PPNR).
- Best practices for forecasting macroeconomic conditional PPNR.
- Tools and techniques used by Moody's Analytics to address the challenges and/or close any gaps between best practices and current challenges.

Register at: http://www.cvent.com/d/64q8kn/4W

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Questions?

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