Stress Testing Methodology

Retail Lending

Portfolio Loss

Estimation

Session Objectives

1. Overview
2. Common Retail Portfolios
3. Loss Forecasting Methodologies
4. Documentation
5. Independent Validation
6. Regulatory Review

Objective 1: Overview

1. **Overview**
2. Common Retail Portfolios
3. Loss Forecasting Methodologies
4. Documentation
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Overview

- Retail Credit Risk
  - Retail Portfolios represent significant portions of banks' asset base
  - Certain banks like standalone Credit Card or Auto lenders are predominantly exposed to retail credit risk
  - Retail loan defaults are very susceptible to macroeconomic conditions – and not in a linear fashion
  - The starting point for the 2007-2009 recession in US

Overview

- Quantitatively Based
  - Retail data tends to be granular, voluminous, relatively homogenous, and with many defaults
  - Long history of record keeping and of forecasting credit losses for reserve accounting
  - Relatively well established retail risk metrics in the US such as FICO, CLTV (HPI, BPO), Used Car index et al
  - Defaults and to a less extend final collateral dispositions occur at equivalent intervals after some macroeconomic shift

Objective 2:
Common Retail Portfolios

1. Overview
2. **Common Retail Portfolios**
3. Loss Forecasting Methodologies
4. Documentation
5. Independent Validation
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Common Retail Portfolios

- Mortgages – the largest and most significant
  - First Lien Mortgages
  - Second Lien Mortgages
  - Home Equity Loans (HELOANs)
  - Home Equity Lines of Credit (HELOCs)
  - International Mortgages
- Credit Cards – Large, especially for select standalone banks
- Auto Loans – Large, especially for select standalone banks
- Student Loans – Relatively small
- Small Business Loans – Relatively small
- Other Consumer Loans – Relatively small

Objective 3:
Loss Forecasting Methodologies

1. Overview
2. Common Retail Portfolios
3. **Loss Forecasting Methodologies**
4. Documentation
5. Independent Validation
6. Regulatory Review

Loss Forecasting Methodologies

- Econometric or Expected Loss Approach
  - The most encountered type of models
  - Idea already implanted by Basel
- Conditioned Roll Rate Models
  - Widely used initially
  - Modified version of the already utilized Reserve Accounting
- Vintage Loss Curves
  - Present intuitive appeal
  - Rarely used in Conditional Stress Testing
- Net Credit Loss Models
  - One of simplest methodologies

Econometric or Expected Loss Approach

- EL = PD x LGD x EAD
  - Each is modeled separately
  - Suitable in most cases – particularly for Mortgages
  - Proven theoretical and conceptual foundation
- Benefits
  - Ability to decouple risk drivers affecting default frequency, severity, and draw respectively
  - Ability to transcend base scenario backtesting to stress scenarios
  - Ability to single out the component(s), which do(es) not perform well
- Pay particular attention to
  - Severity (LGD) dependent on macroeconomic conditions
  - LGD definition and time on which it is measured
  - Backtesting results for each component

Econometric or Expected Loss Approach - Example

- Bank A uses an Econometric Approach on its Mortgages
  - It *segments* its mortgages by
    - Prime Conforming Mortgages
    - Jumbo Mortgages
    - Subprime Mortgages
    - ARM (Adjustable Rate) Mortgages
  - For each segment it develops a logistic regression model to estimate next 12 months *default frequency (PD)* accounting for:

Portfolio Risk Drivers

- Loan Age – Months-to-books
- Original Credit score (FICO)
- Original Loan-to-Value (LTV)
- State Indicator

MacroEconomic Risk Drivers

- 12-month Change in Unemployment - lagged 6 months
- 12-month Change in HPI index - lagged 6 months

Econometric or Expected Loss Approach - Example

- For each segment, Bank A develops a linear regression model (OLS) to estimate losses on an account that has defaulted - *Loss, given default (LGD)* accounting for:

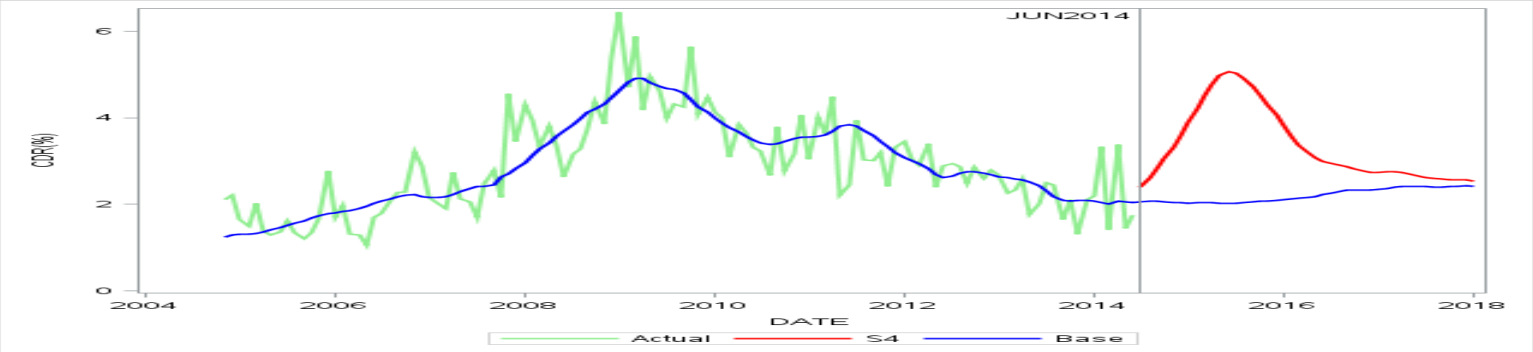
Portfolio Risk Drivers

- Credit Score (FICO)
- State Indicator

MacroEconomic Risk Drivers

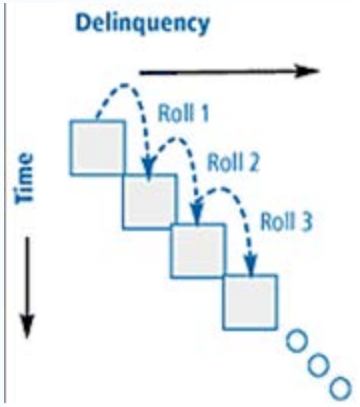
- 12-month Change in HPI index - lagged 6 months

- Bank A does not have a separate *Exposure – at – default (EAD)* module as mortgages do not include lines of credit.
- Thus, there are 8 models all together. Models are statistically significant and *backtesting* appears to support their use.



Conditioned Roll Rate Models

- Vestige from the Reserve Accounting
  - Easily understood by banks' management
  - Well suited for homogenous segments
  - Long history of effective short-term forecasting
  - Requires a significant amount of data points



- Benefits
  - In its most advanced level is like a PD x LGD x EAD model except that PD is split into several buckets
  - Useful in bridging in other more sophisticated approaches (phased out in 1-4 quarters)
  - Can be supplemented by severity and EAD component
  - Good choice for a benchmark model

Conditioned Roll Rate Models

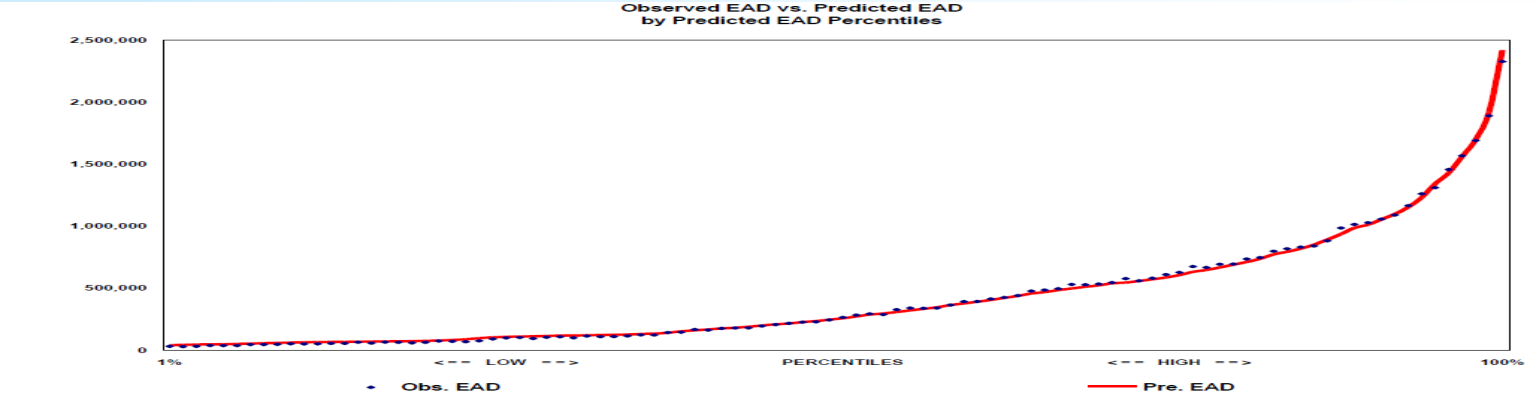
- Pay particular attention to
  - Segmentation is key to capturing portfolio risk drivers
  - Sensitivity to macro economic conditions
  - Separate model for severity

Conditioned Roll Rate Models– Example

- Bank B uses a conditioned Roll Rate Model on its Credit Card portfolio
  - It *segments* (33 in total) its mortgages by:
    - Consumer/Business Cards, FICO Band, Line Utilization
  - For each segment it develops a probit regression model to estimate the roll of each delinquency bucket to the next for:
    - Current & 1-29 to 30-59
    - 30-59 to 60-89
  - It uses 12-month Change in Unemployment - lagged 6 months as the only variable
  - Bank B found no statically significant models for:
    - 60-89 to 90-119
    - 90+ to default
  - Instead, it uses their long-run average which is close to 90% under any economic scenario

Conditioned Roll Rate Models– Example

- Bank B employs a linear regression model (OLS) to estimate *Exposure – at – default (EAD)* for the portion of the portfolio predicted to default.
- It uses 12-month Change in HPI index - lagged 6 months as the only explanatory variable
- Credit Card debt is unsecured loans and Bank B finds its *losses given default (LGD)* to be high under all scenarios. It cannot find a statistically significant model to distinguish between different economic environments. Therefore, it assumes a conservative 95% LGD under all scenarios.
- Backtesting results look reasonable:



Vintage Loss Curves

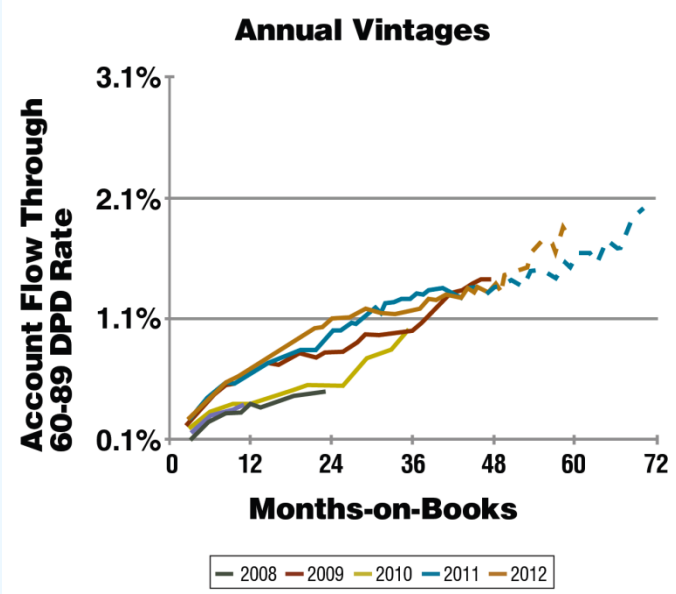
- Seasoning effect
  - Vintage curves are built by grouping loans based on their time on books – e.g loans that have 3 months on books are grouped together even though they come from different periods
  - Employed in portfolios with strong pronounced seasoning effect (autos, et al)
  - Time dimension used for seasoning effect not suitable for conditioning on macroeconomic scenarios
  - Losses due to stressed economic conditions are often layered on top – this invalidates backtesting results for the stress scenarios
  - Can be reasonable captured in an econometric model by a months-on-book variable

Vintage Loss Curves

- Benefits
  - Well suited to capture the seasoning effect (maturity)
- Pay particular attention to
  - Conditioning on macroeconomic scenarios
  - Backtesting results

Vintage Loss Curves - Example

- Bank C estimates losses on its Auto Loans using Vintage Loss Curves
  - It segments its Auto Loans into
    - Used
    - New
  - Builds vintage loss curves for each segment to estimate base (normal) losses
  - Builds a separate simple linear regression model estimating the additional losses the portfolio would incur under severe economic conditions. The OLS model uses Manheim (Used Car) Index as an explanatory variable.



Net Credit Loss Models

- Net Credit Losses are always available
  - Easily regressed in a time series model
  - No ability to decouple separate components
  - Limited ability to capture portfolio risk drivers
  - Assumes the portfolio's characteristics have been and will be the same
  - Unsuitable as a champion model for large and complex portfolios

Net Credit Loss Models

- Benefits
  - One-stop-shop for a loss forecasting model
  - Good choice for a crude benchmark model
- Pay particular attention to
  - Segmentation is key to establish homogenous portfolios
  - Change in accounting definitions for losses
  - Out-of-time backtesting

Net Credit Loss Models - Example

- Bank D uses a Net Credit Loss Model to estimate losses on its Student Loan Portfolio
  - It *segments* out its Student portfolio into:
    - Loans to Students attended State Institutions
    - Loans to Students attended Private Institutions
    - Loans to Students attended For-Profit Institutions
  - For each segment, it builds a separate simple regression model (OLS) using 12-month Change in Unemployment - lagged 12 months, as a explanatory variable.

Objective 4: Documentation

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Documentation

- Two separate types needed
  - Advanced technical documentation
  - Plain summary documentation
- Advanced Technical Documentation to include:
  - The design, theory, and logic underlying the methodology
  - Referenced data set along with any data exclusions, manipulations, or sampling
  - Time period in the training sample and out-of-time backtesting
  - Portfolio segmentation

Documentation

- Advanced Technical Documentation cont'd:
  - Explanatory variables selected as well as the ones tried but ultimately not selected along with justification for the final selection
  - Statistical output confirming final model's goodness-of-fit
  - Backtesting results
  - (Any) Qualitative adjustments applied
- Plain Summary Documentation
  - Easy-to-read succinct summary of the applied methodology
  - Devoid of quantitative jargon or complicated mathematical formulas

Objective 5: Independent Validation

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Independent Validation

- Performed by an independent party
  - Separate group within the organization with independent reporting structure
  - Individuals who were not part of the model development team
  - External party with appropriate incentive arrangements
  - Independent enough to call the model(s) unfit for use if needed
- Qualified individuals
  - Model validation skill set should be at least as good as the one from model development
  - Pay structure and other performance incentives should be comparable

Independent Validation

- Thorough review should include:
  - Review of the conceptual soundness
  - Data, code, and final output replication
  - Outcome analysis
  - (Any) Findings along with their severity and potential impact

Objective 6: Regulatory Review

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Regulatory Review

- Very Much like Independent Validation
  - Large emphasis on conceptual soundness
  - Large emphasis on outcome analysis
  - Limited review of the code, statistical output, and final reports
- Heavy involvement of quantitative analysts
  - Review the advanced technical documentation
  - Conduct questions and answers sessions with banks' representatives
  - Prepare reports explaining in 'plain language' methodologies' strengths and especially weaknesses
  - Determine significant issues and their severity
  - Articulate findings tying issues to formally issued supervisory requirements