



# **Approaches to Modeling Credit Card Portfolios**

**Stress Testing Model Symposium  
Federal Reserve Bank of Boston**

**Presented by:  
Peter A. Schnall  
Chief Risk Officer**

# Agenda

- **Overview of Capital One's approach to modeling Credit Card charge-offs**
- **Explore issues in modeling that may require consideration of BHC specific effects**
- **Propose a principled approach to continuously improve models and to incorporate BHC-specific variation**

# Our approach to modeling credit card charge-offs

## PD

## EAD

## LGD

### Approach

- |   |  |  |
|---|--|--|
| <ul style="list-style-type: none"> <li>• <b>Account level competing hazard survival model with four hazards:</b> <ul style="list-style-type: none"> <li>• Contractual c/o at 180 days</li> <li>• Bankruptcy</li> <li>• Deceased</li> <li>• Attrition</li> </ul> </li> <li>• <b>MSA-level economic effects built into model</b></li> </ul> | <ul style="list-style-type: none"> <li>• <b>Trend forecast by origination vintage</b> <ul style="list-style-type: none"> <li>• Split into key components (e.g. initial line, ratio of bad to good credit line)</li> </ul> </li> <li>• <b>Economic effects applied at national level</b></li> <li>• <b>Some success applying PD models to account level models of credit limit and utilization at charge-off</b></li> </ul> | <ul style="list-style-type: none"> <li>• <b>Basic approach: model sold debt and self-recovery separately</b> <ul style="list-style-type: none"> <li>• Self-recovery modeled using stacked charge-off vintages</li> </ul> </li> <li>• <b>Complex approach: adds separate models for &gt;12 self recovery strategies</b></li> <li>• <b>Economics effects captured by altering recovery timing curve (level and shape) and prices to reflect previous stress</b></li> </ul> |
|---|--|--|

### Data

- |  |   |   |
|--|---|---|
| <ul style="list-style-type: none"> <li>• <b>History from 2002</b></li> <li>• <b>Account level data:</b> <ul style="list-style-type: none"> <li>• Performance</li> <li>• Acct characteristics</li> <li>• Bureau attributes</li> </ul> </li> <li>• <b>MSA-level economic data</b></li> </ul> | <ul style="list-style-type: none"> <li>• <b>Vintage level credit line and utilization trends</b></li> <li>• <b>Historic line increase volumes</b></li> <li>• <b>National economic data</b></li> </ul> | <ul style="list-style-type: none"> <li>• <b>C/O amount and date by account</b></li> <li>• <b>Recovery amount and date by account</b></li> <li>• <b>Strategy entry amount and date by account (for complex approach)</b></li> <li>• <b>National economic data</b></li> </ul> |
|--|---|---|

### Key Features

- |   |   |   |
|---|---|---|
| <ul style="list-style-type: none"> <li>• <b>Separate modeling systems for major business segments</b></li> <li>• <b>Splines for non-linearities</b></li> <li>• <b>Up to 8 sub-models per hazard based on:</b> <ul style="list-style-type: none"> <li>• account age</li> <li>• delinquency</li> <li>• account activity/inactivity</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• <b>Trend forecasts have outperformed PD-based forecasts to-date</b></li> </ul> | <ul style="list-style-type: none"> <li>• <b>Captures timing of self-recovery</b></li> <li>• <b>Allows modeling of management choices (i.e. self recovery vs sale)</b></li> <li>• <b>Complex approach supports staff planning</b></li> </ul> |
|---|---|---|

## Three Issues in Modeling Credit Card Charge-offs

Accounting Issues  
in modeling LGD

Alternatives for  
modeling EAD

Firm- and segment-specific  
effects in modeling PD

- These issues may require firm specific considerations to create accurate models
- **Objectivity Principle: Any approach to including firm specific considerations must be objective, preserve methodological consistency across firms, and reflect independent judgments reached by the Federal Reserve**
- The difficulty of preserving the Objectivity Principle varies by issue

← Easier      Difficulty of Preserving the Objectivity Principle      → More Difficult

# BHC-specific card recovery practices drive variation in both Provision and PPNR due to material differences in accounting

## Accounting Treatments for Different Approaches to Recovery

### Sell Charged-off Debt

- Recovery recognized at time of sale in the credit provision
- Recovery amount determined by the price of sale
  - Implicitly includes cost of recovery
  - Implicitly includes discounted value of lifetime recoveries
- ALLL reflects anticipated sales of future charge-offs



### Self Recover Charge-offs

- Recovery recognized as cash is received from charged-off borrowers
- The amount of cash received is recorded in the credit provision
- The cost of recovery is recorded in operating expense (PPNR)
- ALLL reflects expected cash receipts over the ALLL timeframe



### Proposal

- Collect information about each firm's approach to recoveries and their accounting practices
- Ensure that recovery costs are properly accounted for in PPNR and/or Provision depending on approach being modeled

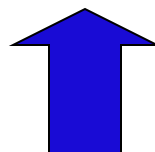
# Three Issues in Modeling Credit Card Charge-offs

Accounting Issues  
in modeling LGD

Alternatives for  
modeling EAD

Firm- and segment-specific  
effects in modeling PD

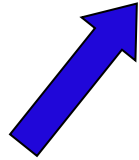
- Collect information about each firm's approach to recoveries and their accounting practices
- Ensure that recovery costs are properly accounted for in PPNR and/or Provision depending on approach being modeled



← Easier      Difficulty of Preserving the Objectivity Principle      → More Difficult

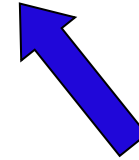
# Variation in Credit Card EAD is driven primarily by variation in Credit Line at Default

$$\text{EAD} = \text{Credit Line At Default} \times \text{Utilization At Default}$$



Driven by:

- Firm level credit line distribution
- Firm level correlation between credit line and default risk (line sloping)
  - Reflects firm's credit strategy

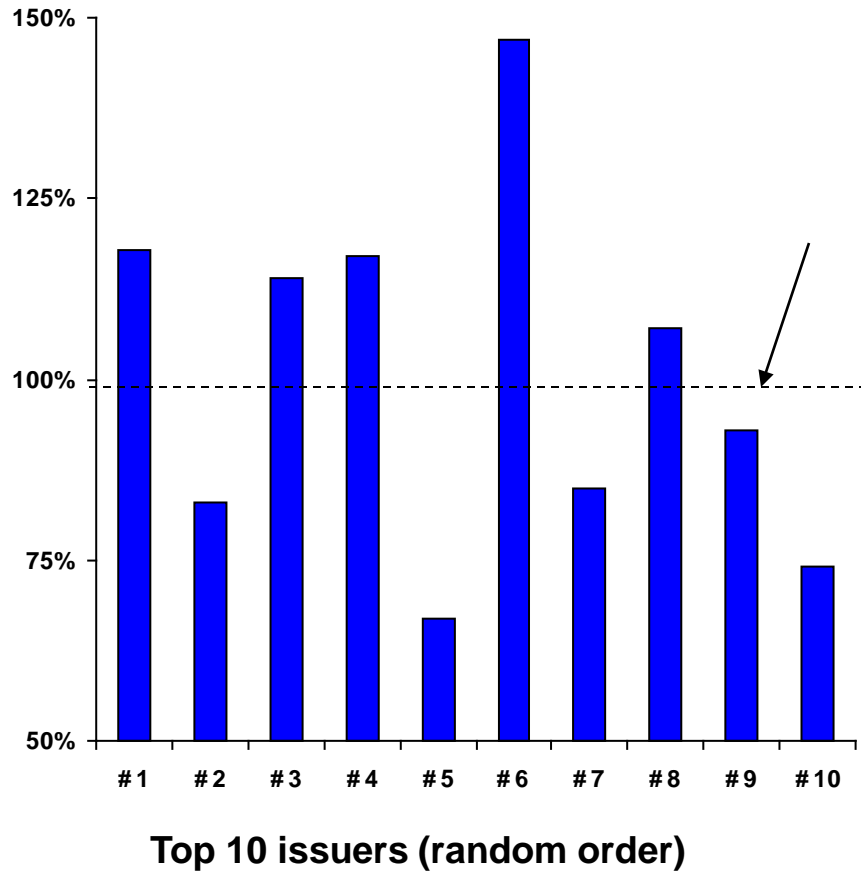


Driven by:

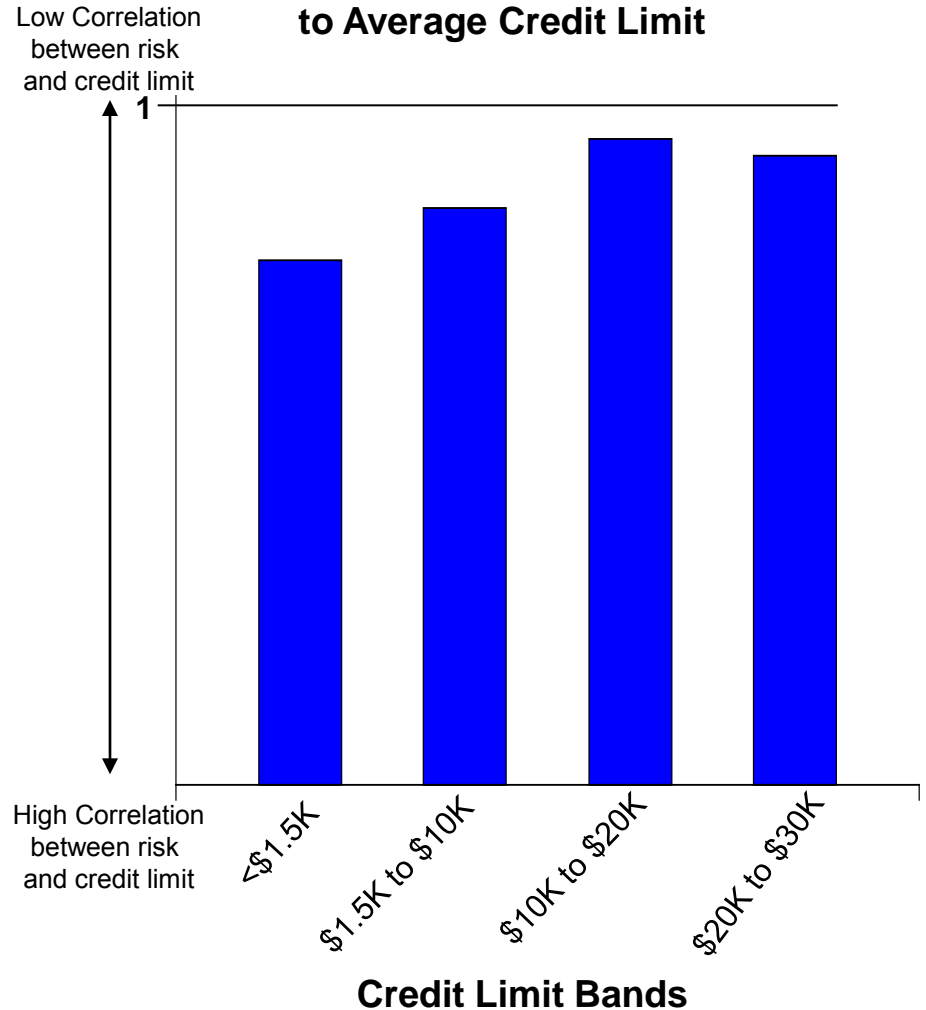
- Charge-off type (bankrupt, contractual, etc.) and other smaller effects
- Has lower variation than credit line at default

# Variation in Credit Limits, even within bands, and in Line Sloping strategies may require a firm specific approach to modeling EAD

## Firm Average Credit Limit as a Percent of Industry Average (for accounts with credit limit < \$1500)



## Effect of Sloping Credit Limit by Risk: Ratio of Credit Limit at Default to Average Credit Limit





# Two approaches to modeling EAD

## Direct Modeling Using Account Level PD Model

- Apply an account level PD model to the expected EAD for each account to estimate total EAD
- Calculate each account's contribution to EAD by multiplying PD x Credit Limit x Utilization at Charge-off

	PD	Expected EAD for each acct		<u>Contribution to EAD</u>
		<u>Credit Limit</u>	<u>Utilization at charge-off</u>	
Account # 1	2.2%	\$1,000	80%	\$18
Account # 2	1.5%	\$2,500	82%	\$31
Account # 3	0.9%	\$15,000	90%	\$122
Account # 4	0.7%	\$25,000	95%	\$166
Account # 5	0.4%	\$27,500	95%	\$105
<b>Total</b>	<b>1.1%</b>			<b>\$441</b>

- This approach fully accounts for variation in credit limit distribution and the correlation between credit limit and risk (line sloping)
- **Caution:** the PD model needs to be valid for each credit limit at the firm level to avoid significant distortion. Firm level PD effects may complicate the approach.

## Firm Level Trend Modeling

- Develop time series for each firm's EAD by credit limit band
  - Modeling components such as Credit Limit at Charge-off and Utilization at Charge-off may improve intuition
- Consult with on-site examiners to identify any expected disruptions to the trend (e.g. recent changes to a credit line increase program)
- In our experience, EAD trends move relatively slowly and yield accurate results
- EAD trends reflect persistent, firm level differences in credit limit distributions and the correlation between credit limit and risk (line sloping)
- EAD trend modeling is easier to implement than Direct Modeling and less prone to unintended distortion

# Three Issues in Modeling Credit Card Charge-offs

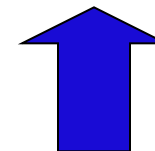
## Accounting Issues in modeling LGD

- Collect information about each firm's approach to recoveries and their accounting practices
- Ensure that recovery costs are properly accounted for in PPNR and/or Provision depending on approach being modeled

## Alternatives for modeling EAD

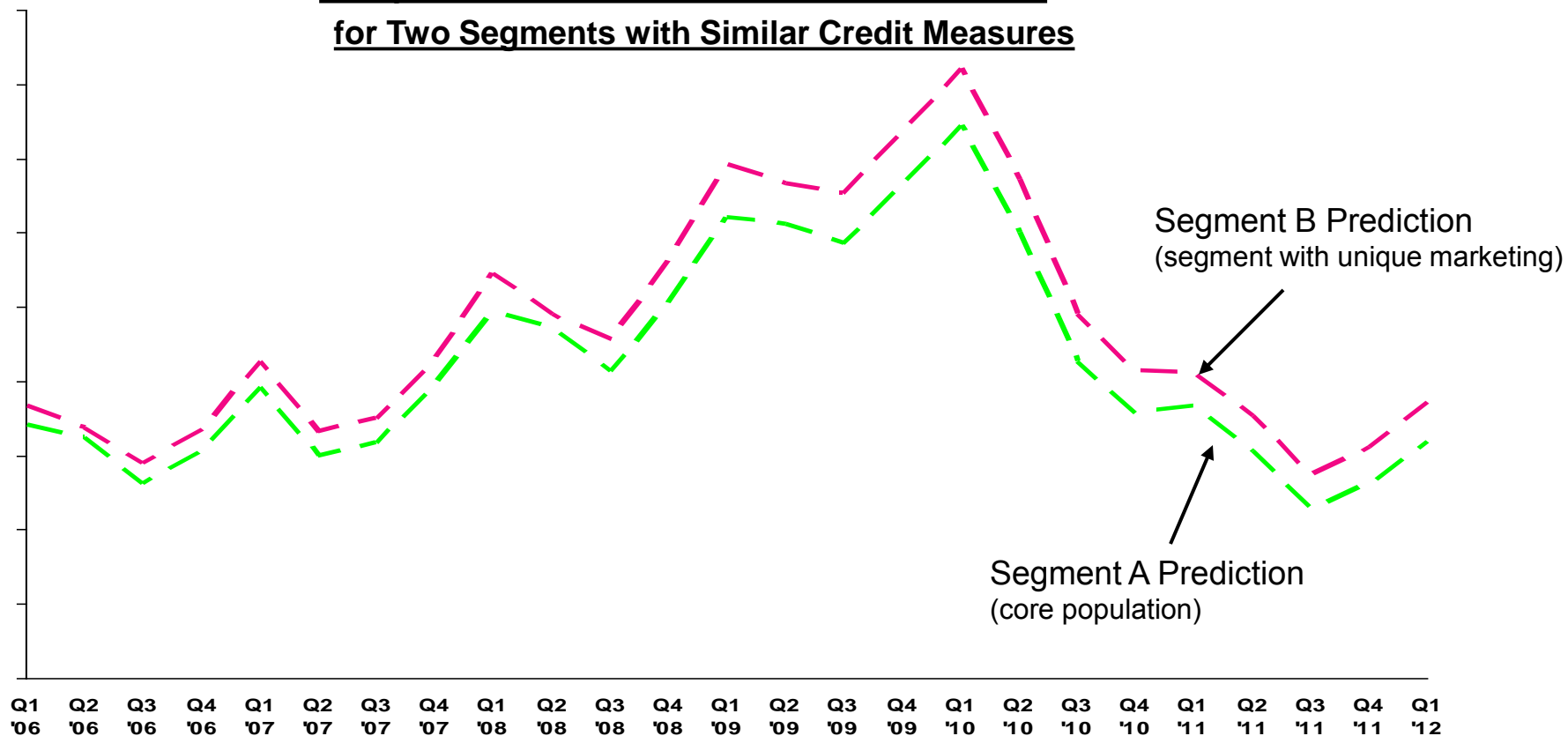
- EAD models should reflect variation in credit limit distributions and in the correlation between credit limit and risk (line sloping)
- EAD can be modeled directly by applying an account level PD model to each account's credit line (although this requires that the PD model be accurate at the credit line level)
- EAD can also be modeled by considering firm specific trends.
  - These trends tend to move slowly and are good proxies for line sloping

## Firm- and segment-specific effects in modeling PD



# We use segment indicators in our PD models to capture differences in marketing and customer management strategies for certain segments (1 of 3)

## Comparison of Core Model Default Predictions for Two Segments with Similar Credit Measures

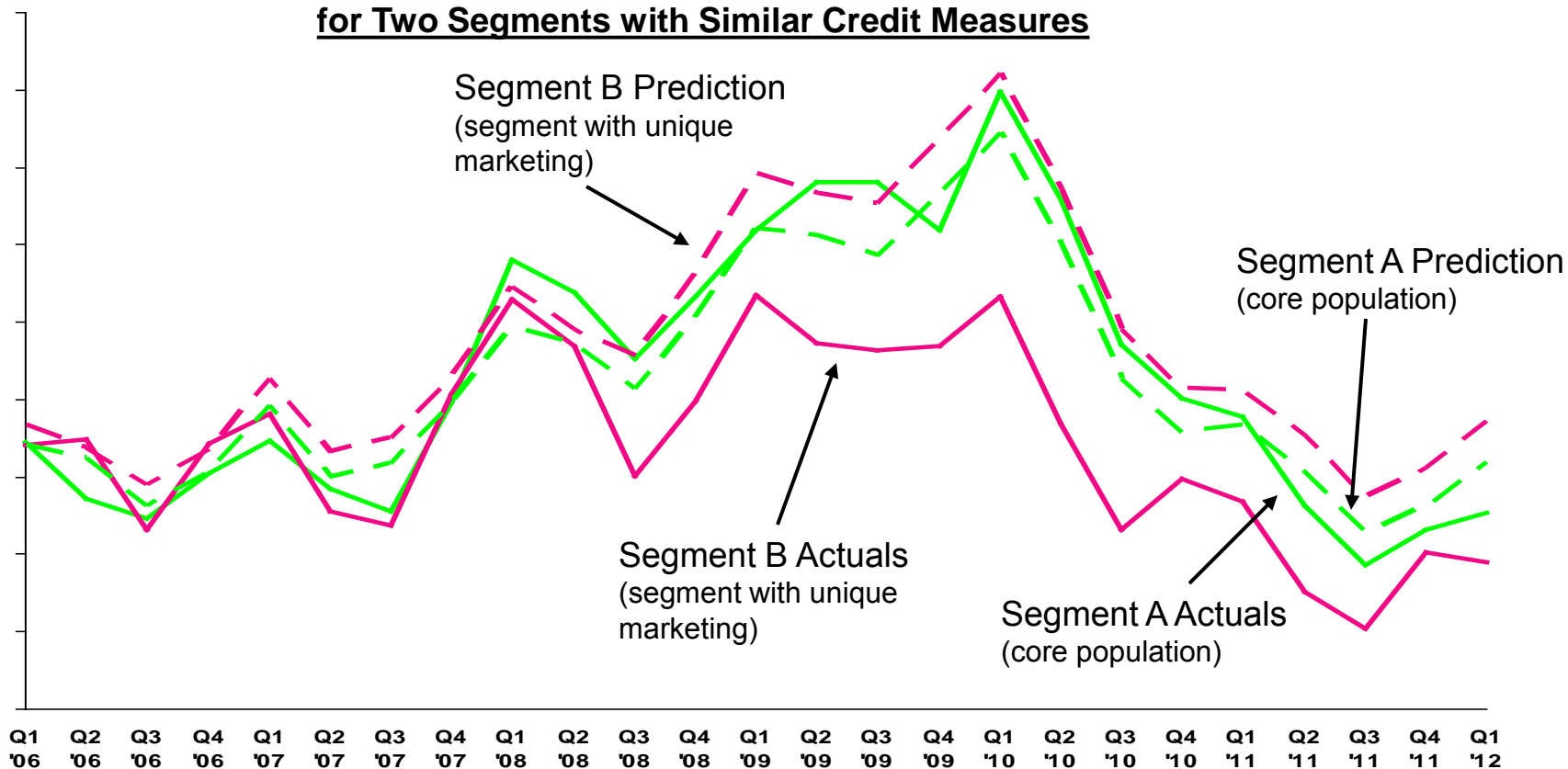


### Observations:

- Model predicts similar performance for Segments A and B

# We use segment indicators in our PD models to capture differences in marketing and customer management strategies for certain segments (2 of 3)

## Comparison of Actual Defaults and Core Model Predictions for Two Segments with Similar Credit Measures

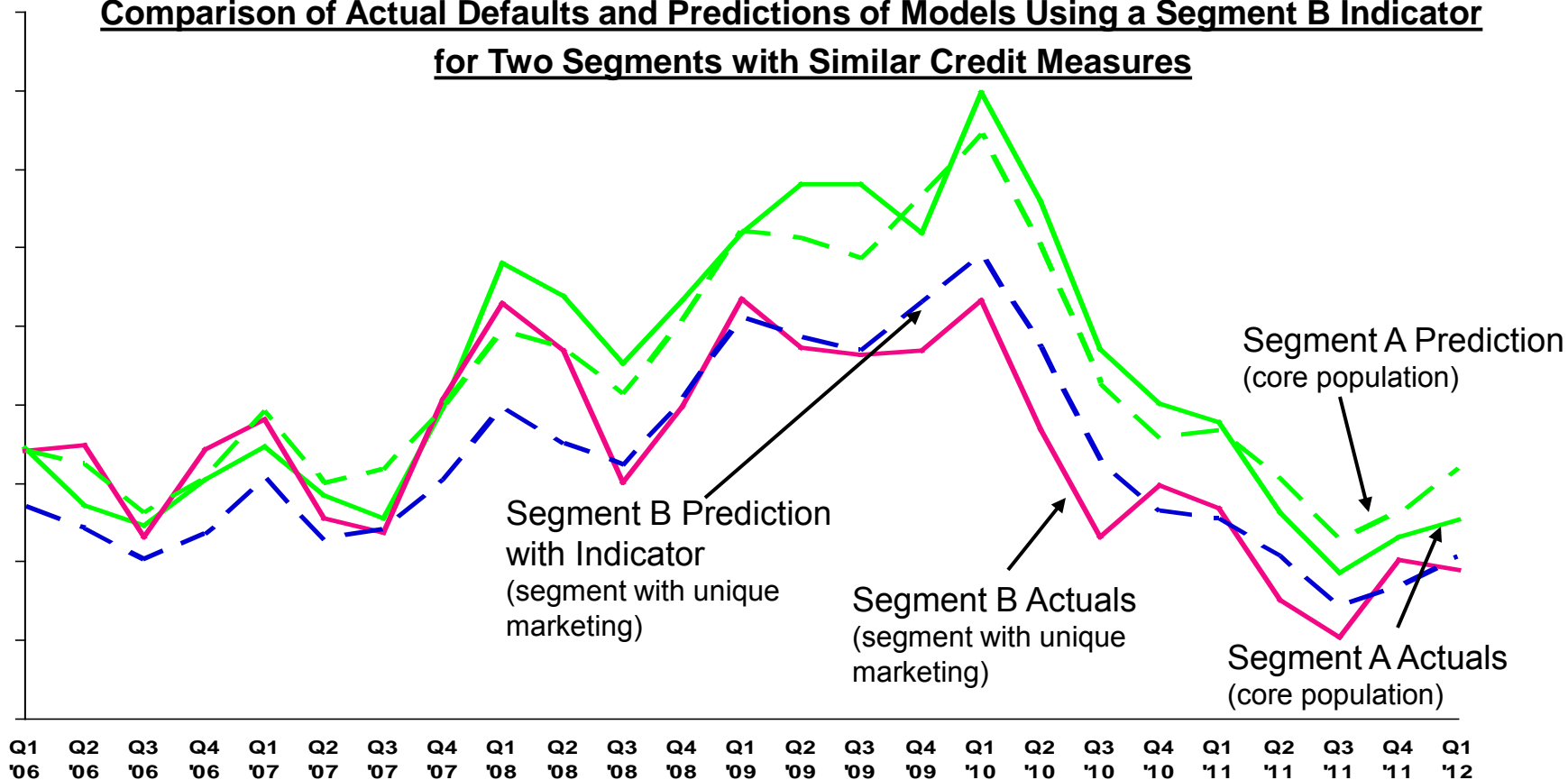


### Observations:

- Segment B actuals are much better than Segment A's and than the core model prediction
- Segment B variance is due to a multi-faceted marketing approach that is designed to appeal to customers with higher potential. We cannot isolate account-level variables that pick up the difference in marketing approach.

# We use segment indicators in our PD models to capture differences in marketing and customer management strategies for certain segments (3 of 3)

Comparison of Actual Defaults and Predictions of Models Using a Segment B Indicator for Two Segments with Similar Credit Measures



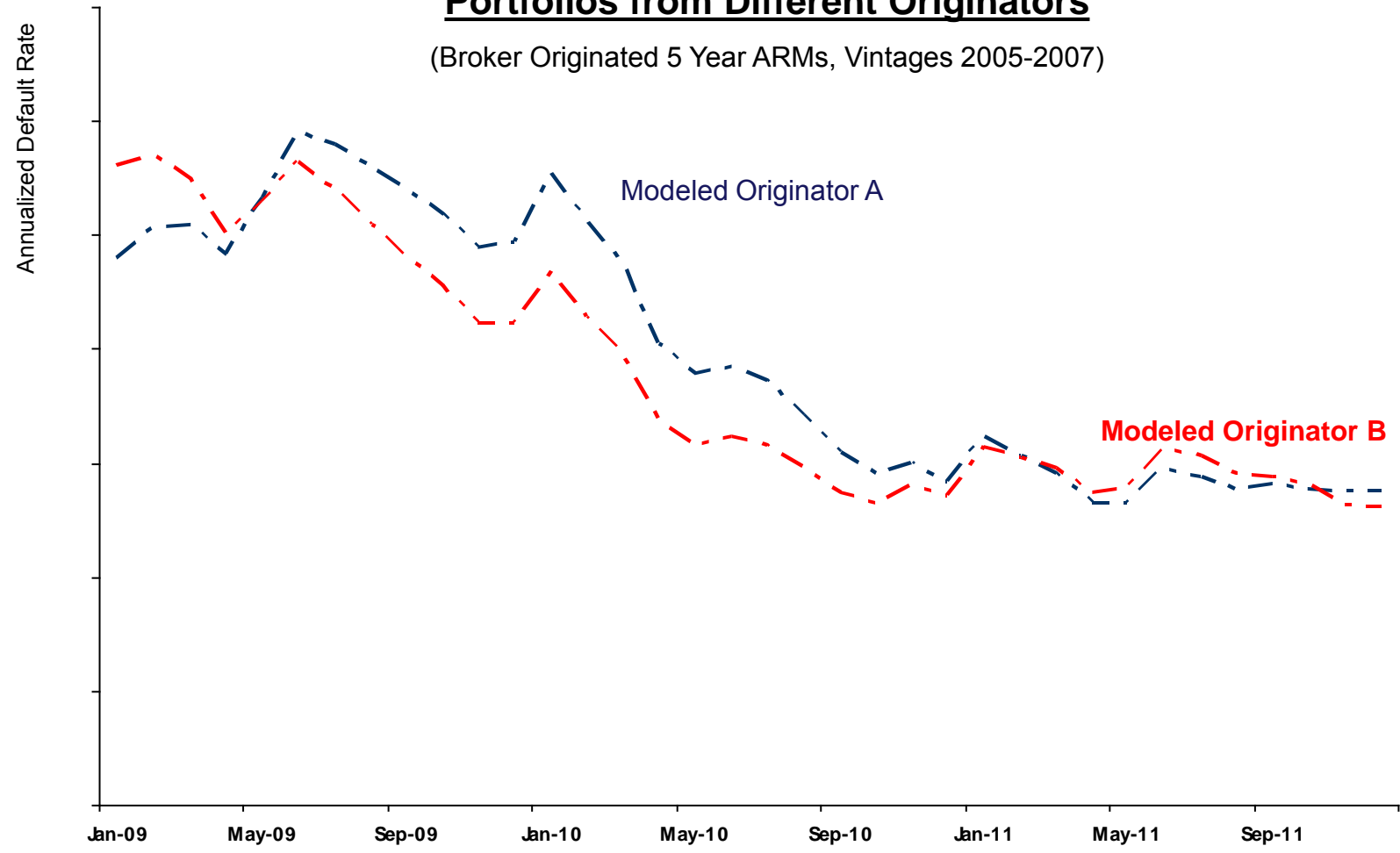
## Observations:

- Adding Segment B indicator to the model to represent the aggregate difference in marketing approach is statistically valid and corrects the prediction over a long-time frame

# Industry level PD models do not capture originator specific effects (mortgage example)

## Comparison Industry Model Predictions for Two Comparable Portfolios from Different Originators

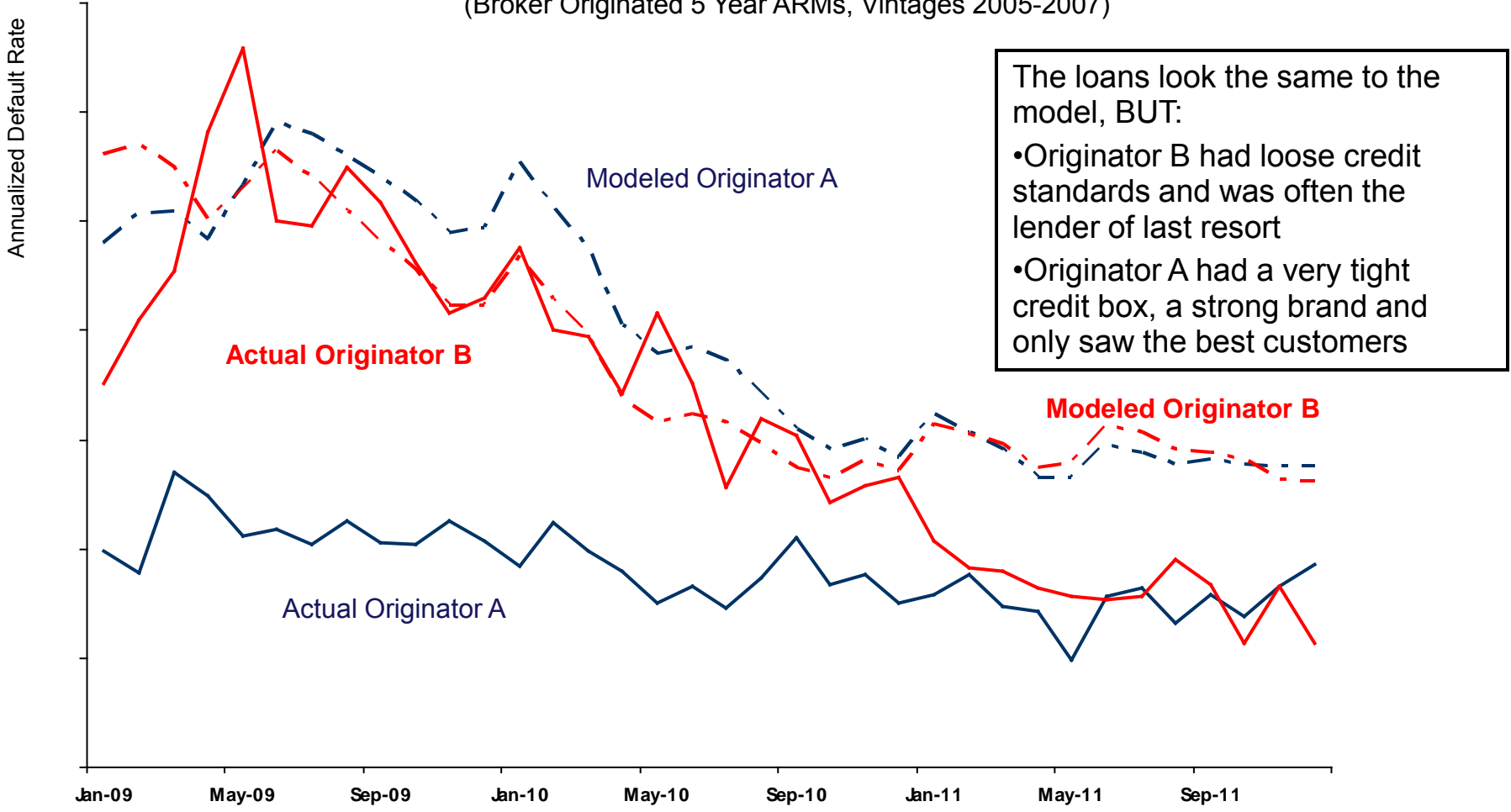
(Broker Originated 5 Year ARMs, Vintages 2005-2007)



# Industry level PD models do not capture originator specific effects (mortgage example)

## Comparison of Actual Default Rates and Industry Model Predictions for Two Comparable Portfolios from Different Originators

(Broker Originated 5 Year ARMs, Vintages 2005-2007)



The loans look the same to the model, BUT:

- Originator B had loose credit standards and was often the lender of last resort
- Originator A had a very tight credit box, a strong brand and only saw the best customers

## **Proposal for handling BHC-specific effects in PD models**

- **Explore statistical robustness and persistence of BHC-specific effects. One method would be to add BHC-specific indicators to the industry model.**
- **For BHC-specific effects that are sufficiently robust, consult on-site examination teams to qualitatively assess the business drivers of the variance and their likely persistence over a two year stress testing horizon**
- **Include partial or full BHC-specific effects which have long duration, statistically significance, and which are judged to have high likelihood to persist over a two year stress horizon**
  - These effects could increase or decrease loss estimates



# Three Issues in Modeling Credit Card Charge-offs

## Accounting Issues in modeling LGD

- Collect information about each firm's approach to recoveries and their accounting practices
- Ensure that recovery costs are properly accounted for in PPNR and/or Provision depending on approach being modeled

## Alternatives for modeling EAD

- EAD models should recognize the variation in line sloping (i.e. how strongly firms reflect default risk when they determine credit lines)
- EAD can be modeled directly by applying an account level PD model to each account's credit line (although this requires that the PD model be accurate at the credit line level)
- EAD can also be modeled by considering firm specific trends.
  - These trends tend to move slowly and are good proxies for line sloping

## Firm- and segment-specific effects in modeling PD

- Use indicators to help explain behavior of segments in industry data that where there is systematic bias
- Create BHC level indicators to measure statistical robustness of any variation from industry level model
  - Consult on-site examination teams to qualitatively assess business drivers of variance and their likely persistence over a two year stress testing horizon
  - Give partial or full credit to BHCs where long duration, statistically significant variation is judged to have high likelihood to persist over a two year stress horizon

← Easier Difficulty of Preserving the Objectivity Principle → More Difficult

# A general approach to managing firm specific variation

**Objectivity Principle:** Any approach to including firm specific considerations must be objective, preserve methodological consistency across firms, and reflect independent judgments reached by the Federal Reserve

