PROCYCLICALITY: IT DEPENDS ON THE MODEL

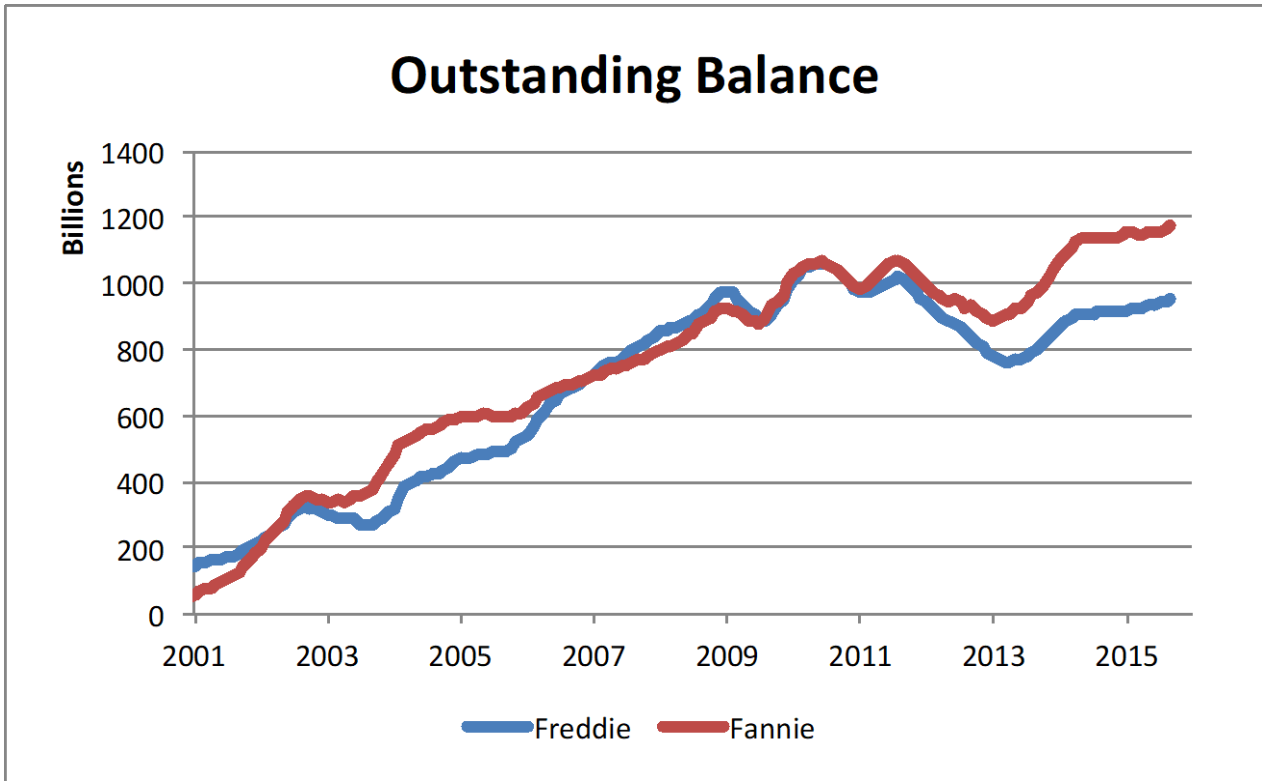
Joseph L. Breeden, Prescient Models
breeden@prescientmodels.com

Research Goals

- Under the new Current Expected Credit Loss (CECL) guidelines, how do loss reserves peak relative to the economic cycle?

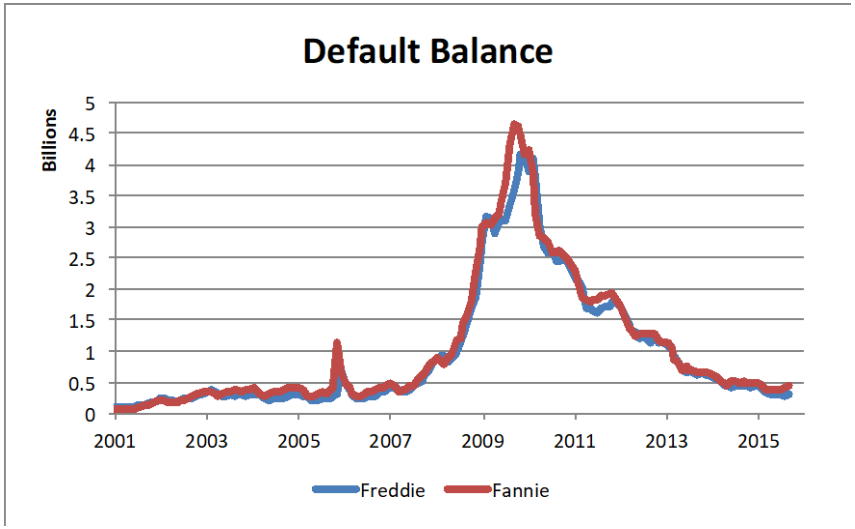
- CECL is roughly equivalent to IFRS 9 Stage 2 lifetime loss modeling.

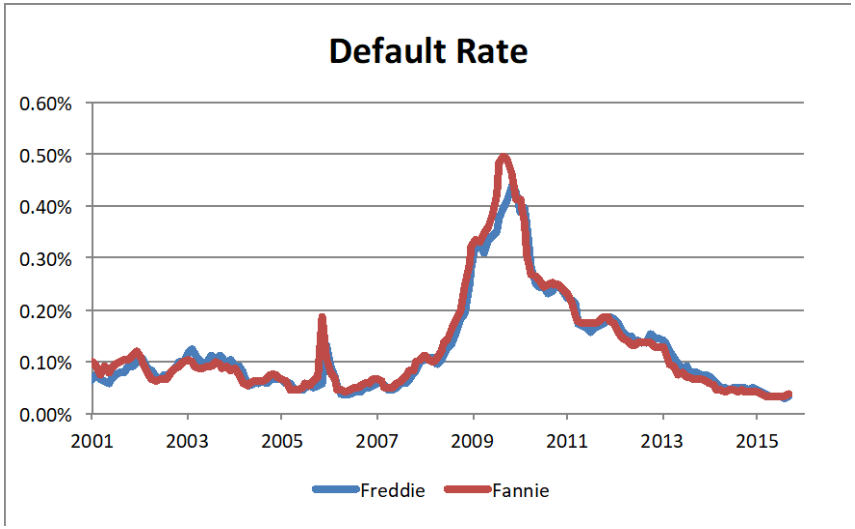
Study Data from Fannie Mae and Freddie Mac



We analyzed all conforming loans from Fannie Mae and Freddie Mac, with performance from 2001 through 2015.

Portfolio Performance Statistics





The recession stands out clearly in the mortgage performance data.

Available Origination Data Fields

The origination data lets us segment by score, LTV, and state.

1	CREDIT SCORE
2	FIRST PAYMENT DATE
3	FIRST TIME HOMEBUYER FLAG
4	MATURITY DATE
5	METROPOLITAN STATISTICAL AREA
6	MORTGAGE INSURANCE PERCENTAGE
7	NUMBER OF UNITS
8	OCCUPANCY STATUS
9	CLTV
10	DTI
11	ORIGINAL UPB
12	LTV
13	ORIGINAL INTEREST RATE
14	CHANNEL
15	PPM FLAG
16	PRODUCT TYPE
17	PROPERTY STATE
18	PROPERTY TYPE
19	POSTAL CODE
20	LOAN SEQUENCE NUMBER
21	LOAN PURPOSE
22	ORIGINAL LOAN TERM
23	NUMBER OF BORROWERS
24	SELLER NAME
25	SERVICER NAME

Available Performance Data Fields

The performance data lets us create a range of models, from aggregate to loan-level.

1	LOAN SEQUENCE NUMBER
2	MONTHLY REPORTING PERIOD
3	CURRENT ACTUAL UPB
4	CURRENT LOAN DELINQUENCY STATUS
5	LOAN AGE
6	REMAINING MONTHS TO LEGAL MATURITY
7	REPURCHASE FLAG
8	MODIFICATION FLAG
9	ZERO BALANCE CODE
10	ZERO BALANCE EFFECTIVE DATE
11	CURRENT INTEREST RATE
12	CURRENT DEFERRED UPB
13	DDLPI
14	MI RECOVERIES
15	NET SALES PROCEEDS
16	NON MI RECOVERIES
17	EXPENSES

MODELS TESTED

Models Considered

The following models have been suggested as possible CECL approaches, and therefore are tested in this study.

- Historic Average
- Time series
- Roll rates
- Vintage
- State transition
- Discrete Time Survival Models

All models are tested at the National and State levels.

Historic Average Model

The model predicts two rates,

- Default Rate = Default Balance(t) / Balance(t-1)
- Pay-down Rate = Pay-down Balance(t) / Balance(t-1)

The average value of these rates for the previous 12 months is used throughout the forecast horizon.

Lifetime forecasts are created by reducing the outstanding balance through either pay-down or default until it reaches $0.

Time Series Model

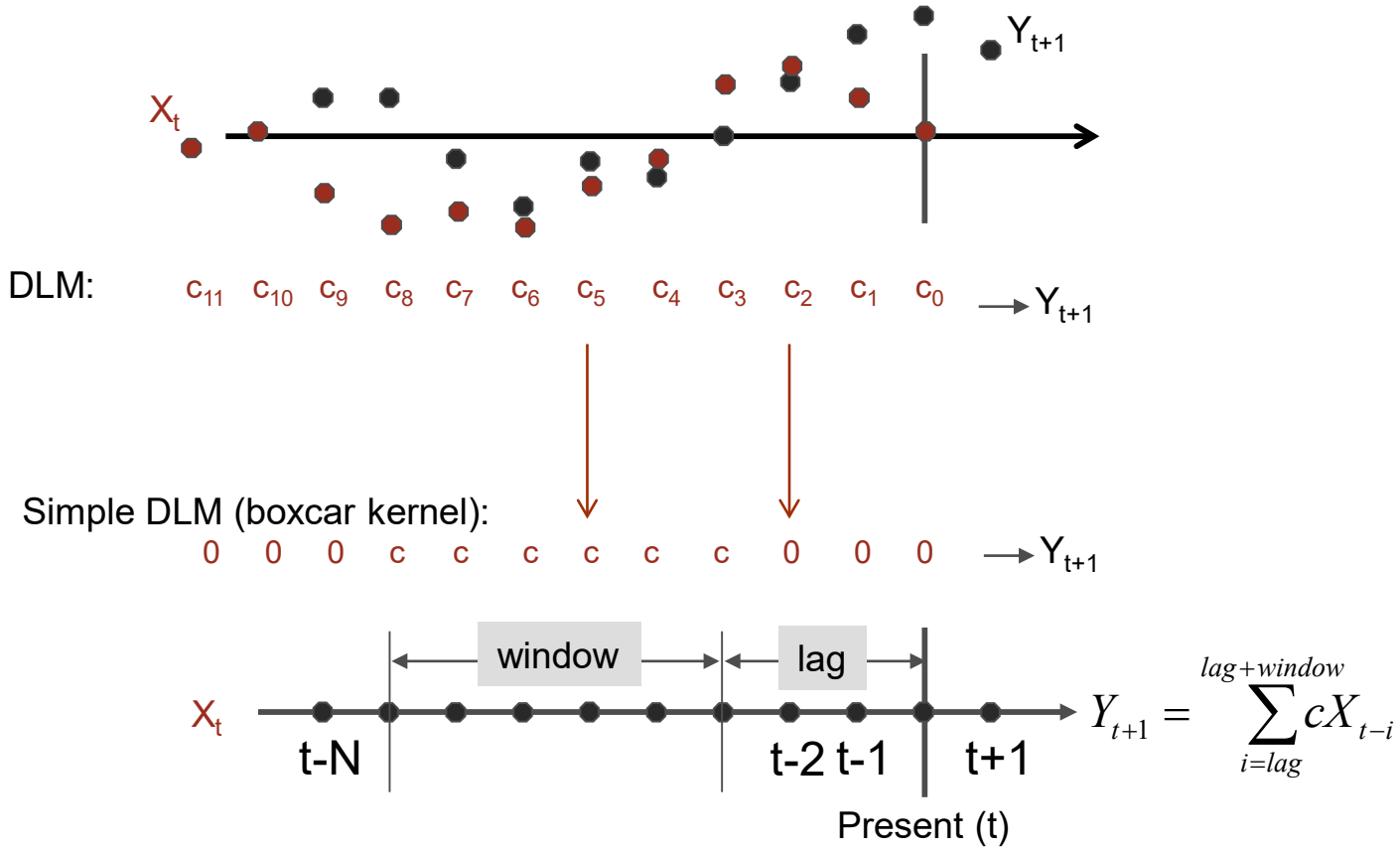
The default rate and pay-down rate time series were modeled with macroeconomic factors.

The following list of macroeconomic variables was chosen from the government-published DFAST scenarios as having the strongest relationships to mortgage performance.

Variable	Transformation
Real GDP	Log ratio
Nominal Disposable Income	Log ratio
Unemployment rate	Moving average
Unemployment rate	Difference
Unemployment rate	Log ratio
House Price Index	Log ratio
Mortgage Interest rate	Difference
DJIA	Log ratio

Illustration of Simplified Distributed Lag Model

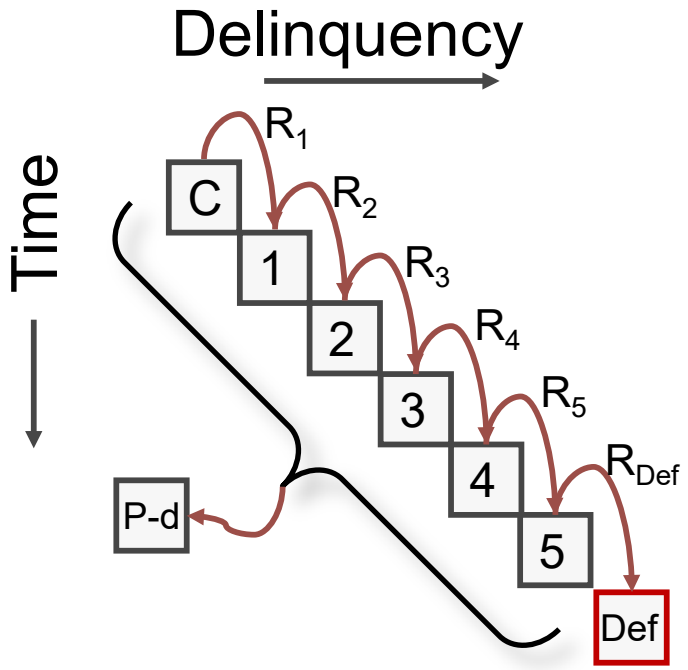
- A structure is assumed between the coefficients to reduce the degrees of freedom.



Roll Rate Model

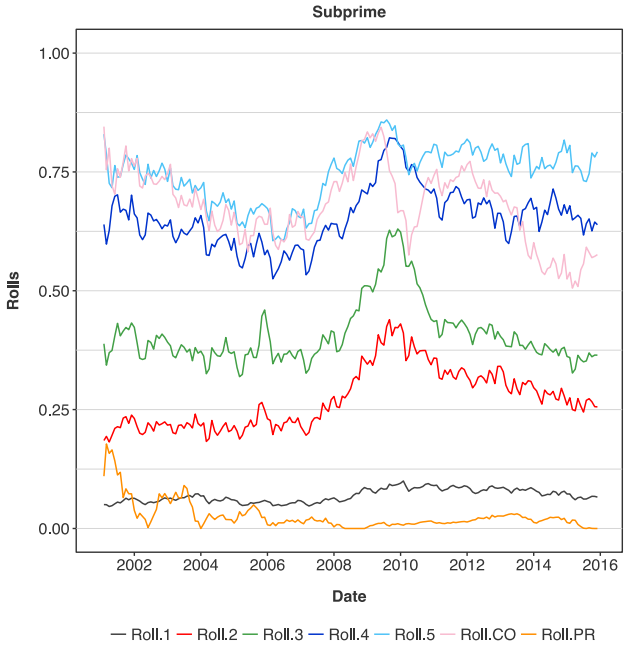
The roll rate model captures the flow of balances from one month to the next, from current through to default.

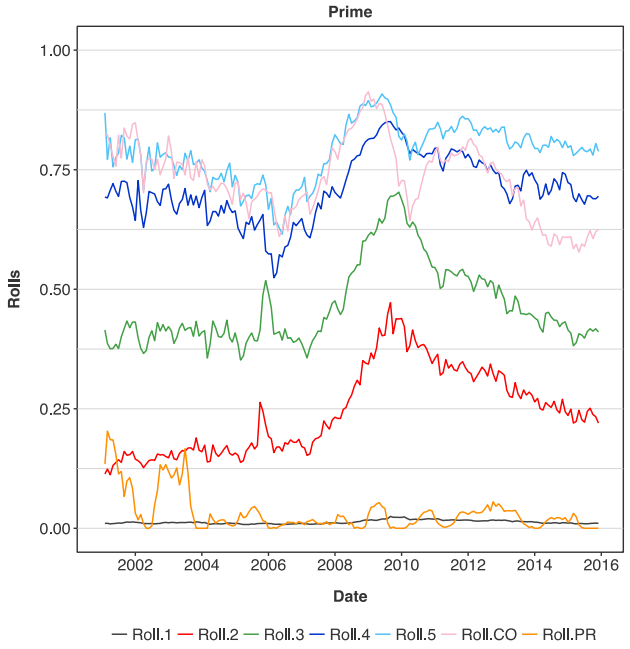
- Current = 0 - 29 DPD
- Bucket 1 = 30 – 59 DPD
- Bucket 2 = 60 – 89 DPD
- Bucket 3 = 90 – 119 DPD
- Bucket 4 = 120 – 149 DPD
- Bucket 5 = 150 – 179 DPD
- Default = 180+ DPD
- Pay-down

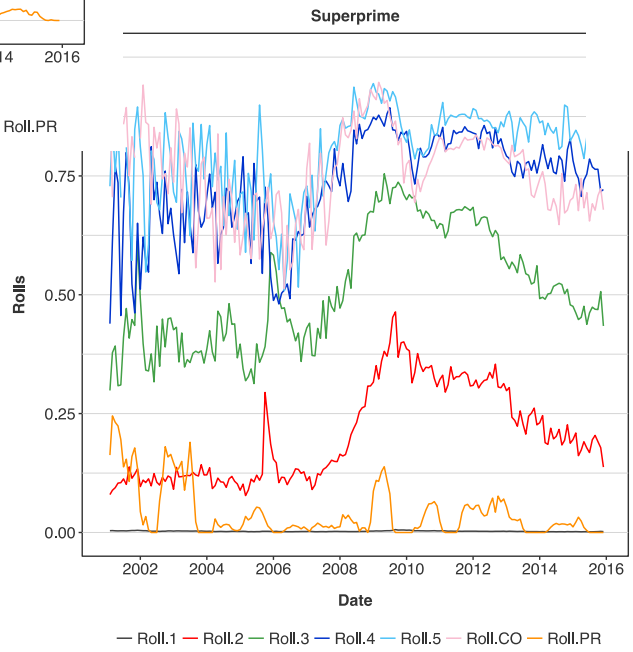


These are "balance rolls", modeling how dollars outstanding roll through delinquency states.

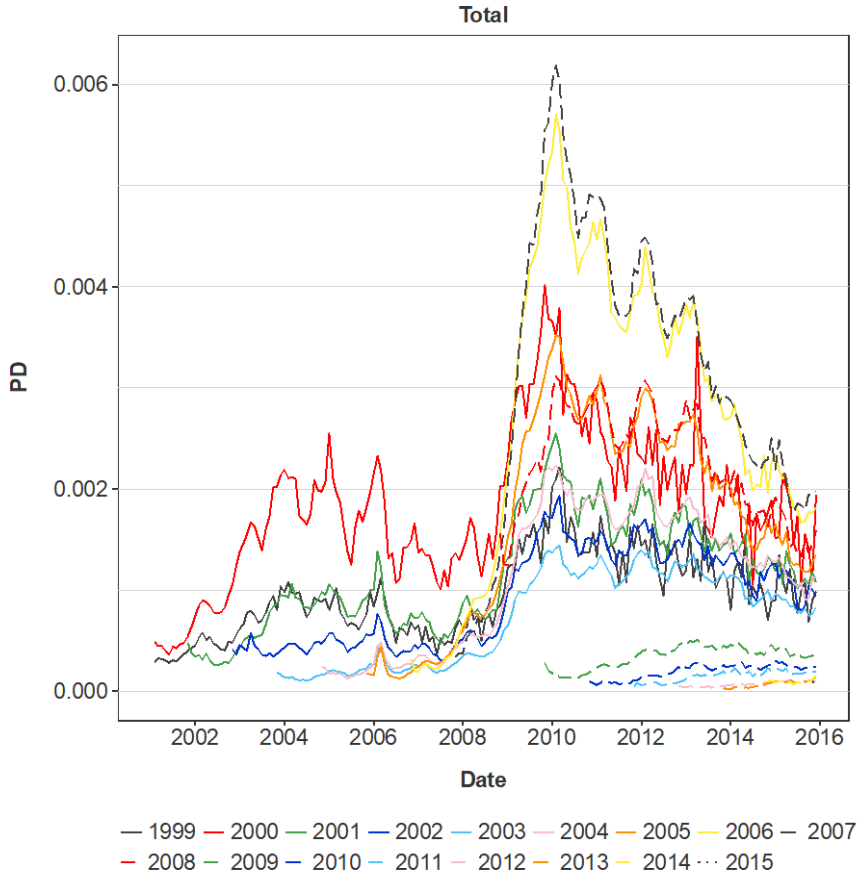
Historic Roll Rates







Vintage Models: Vintage-aggregate Data

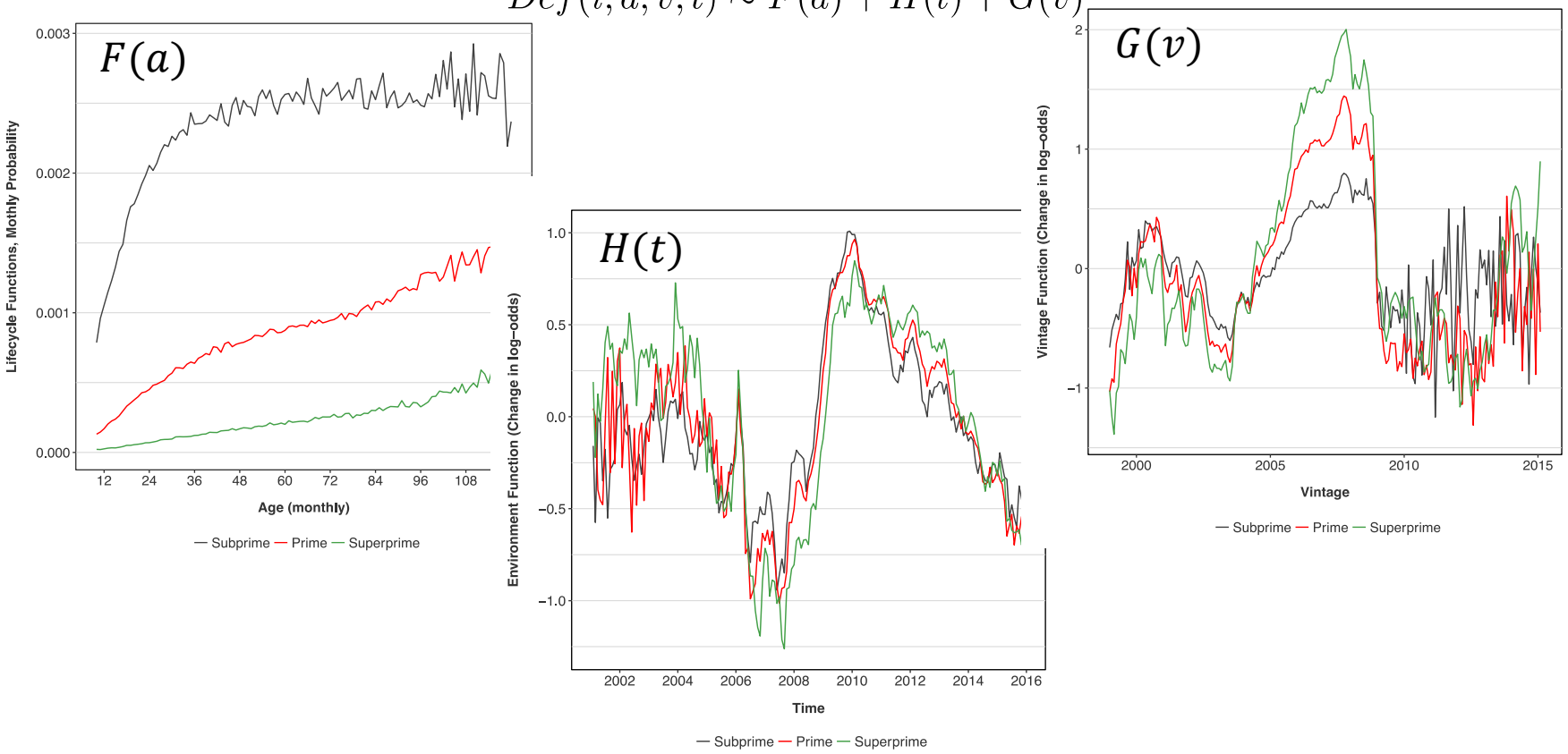


Vintage-aggregate data is created for default rate, attrition rate, outstanding balance, and default balance ratio.

Vintage Models: Default Rate Decomposition

Each key rate is decomposed into a lifecycle versus age of the loan, credit quality by vintage, and environmental impacts by calendar date.

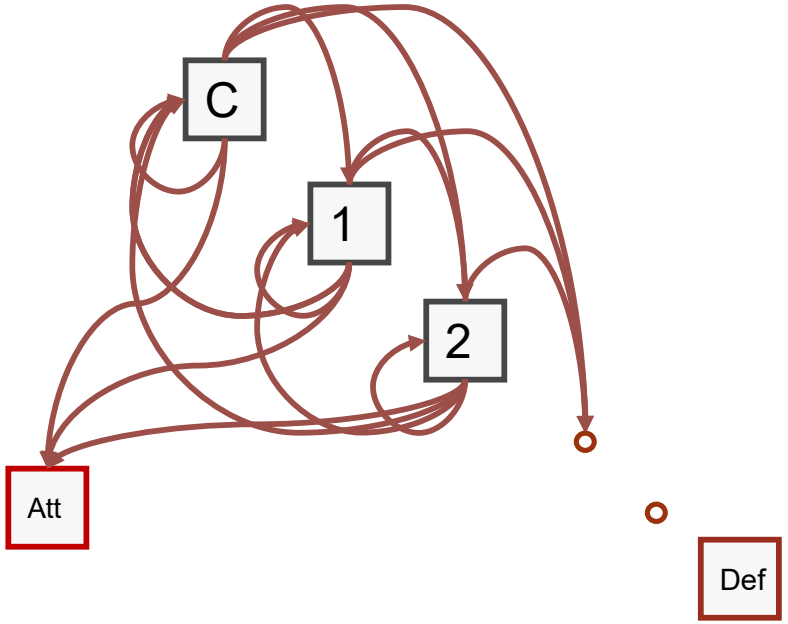
$$Def(i,a,v,t) \sim F(a) + H(t) + G(v)$$



The environment is correlated to macroeconomic factors so that economic scenarios may be used to predict each vintage.

State Transition Models

- State Transition models consider every possible transition between delinquency states, default, and attrition.



State Transition Modeling

- For each active state, a multinomial regression model was created to all observed states in the next time step using macroeconomic and scoring factors.
- Transitions in green were included in the multinomial regression models.
- Transitions in yellow were modeled as moving averages.
- The percentages below show the average transition rates across the full history.

Pr(i->j) %	Current	1m Delq	2m Delq	3m Delq	4m Delq	5m Delq	Default	Attrite
Current	97.38%	0.88%	0.01%	0.00%	0.00%	0.00%	0.00%	1.73%
1m Delq	36.97%	44.88%	16.67%	0.09%	0.02%	0.00%	0.01%	1.35%
2m Delq	12.57%	16.48%	34.31%	35.44%	0.20%	0.03%	0.02%	0.90%
3m Delq	7.08%	3.64%	8.01%	20.45%	59.53%	0.21%	0.08%	0.83%
4m Delq	7.13%	1.14%	1.38%	3.49%	15.32%	69.88%	0.28%	0.80%
5m Delq	6.71%	0.78%	0.51%	0.78%	2.35%	12.46%	74.26%	0.77%

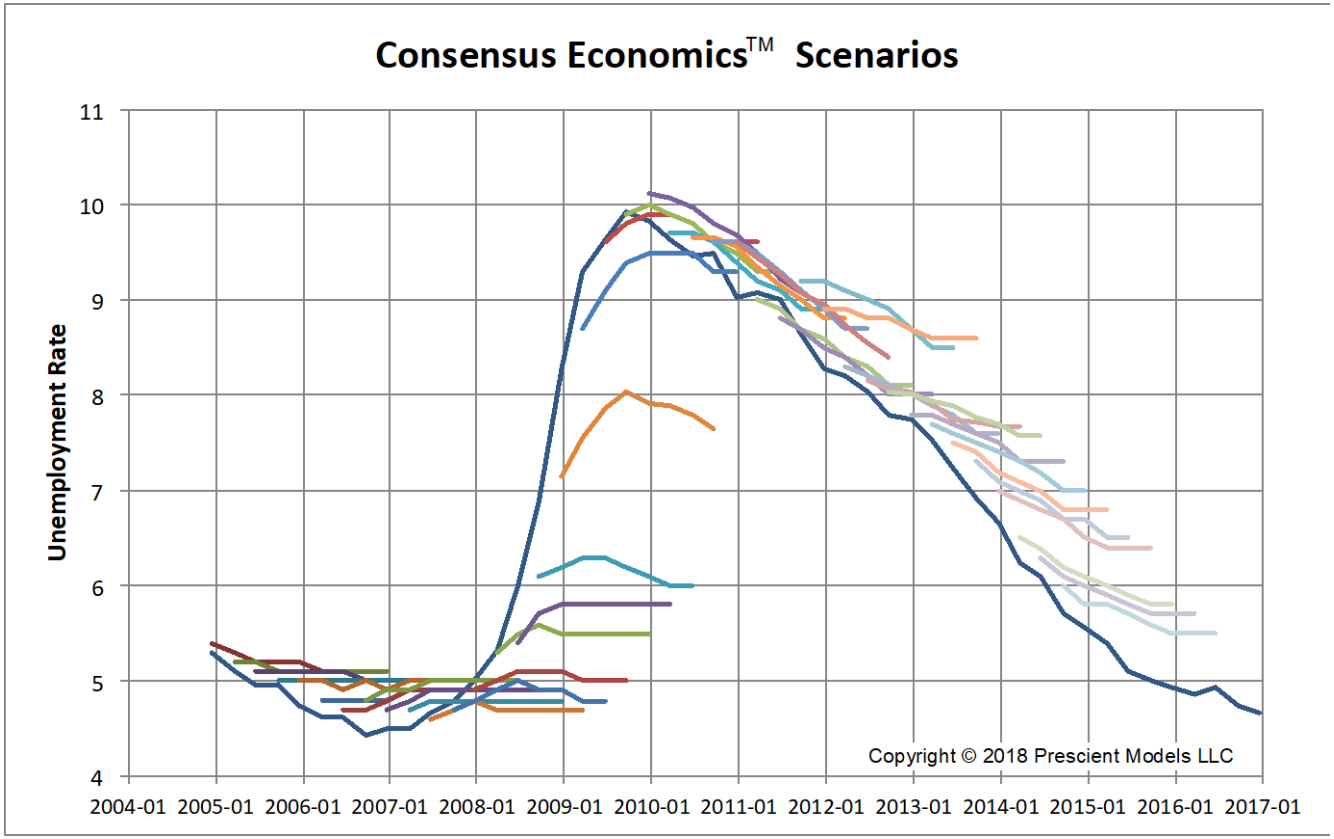
Multihorizon Survival

- We use a vintage decomposition initial step so that we capture all of the lifecycle and environment variation, and so that we control the linear trend ambiguity in age, vintage, time models.
- Then we keep the lifecycle and environment as fixed offsets in a GLM score using quarterly performance data.
- We create origination and behavior scores including typical scoring factors and then test for the inclusion of vintage fixed effects (dummy variables).
- The behavior score coefficients are a function of forecast horizon.

$$\log\left(\frac{p_i(a,v,t)}{1-p_i(a,v,t)}\right)=F(a)+H(t)+c_0+\sum_{j=1}^{n_s}c_j s_{ij}+\sum_{v=1}^{n_v}g_v$$

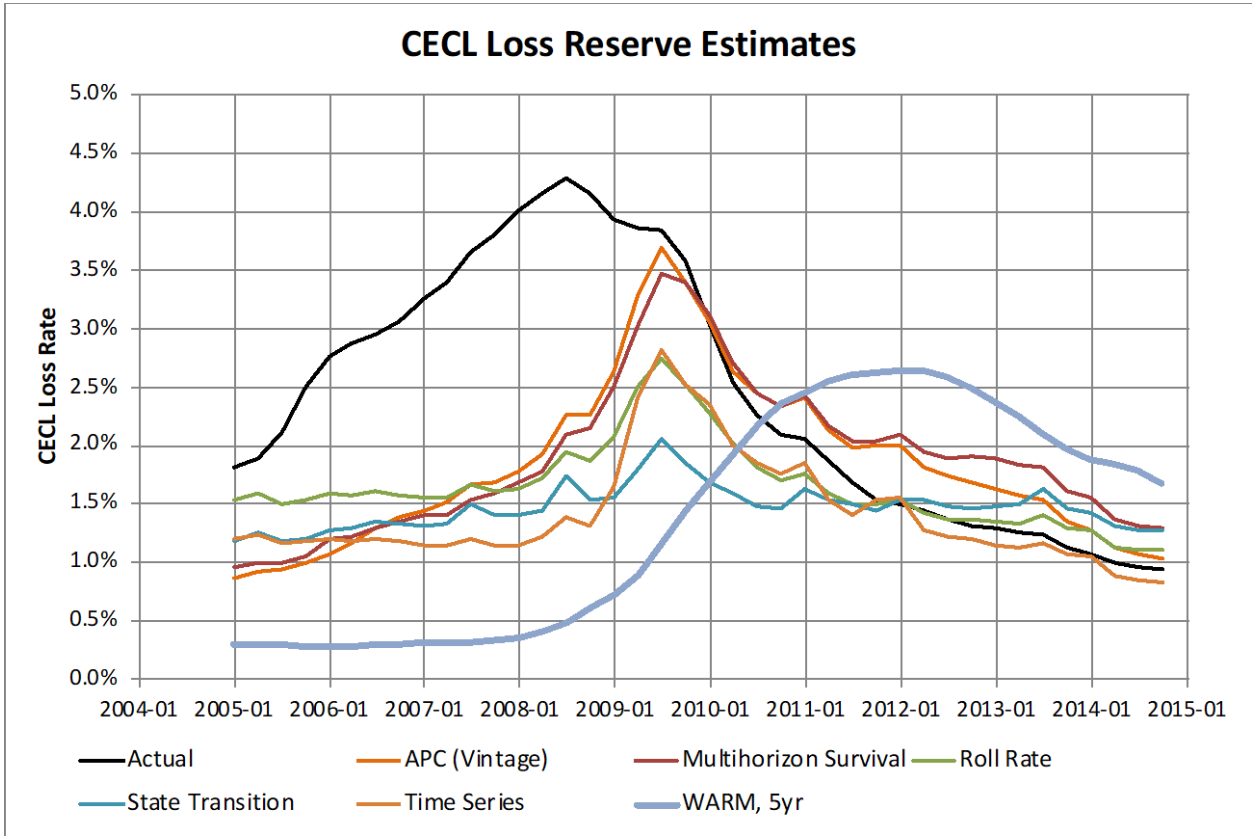
RESULTS SUMMARY

Consensus Economics™ Unemployment Scenarios



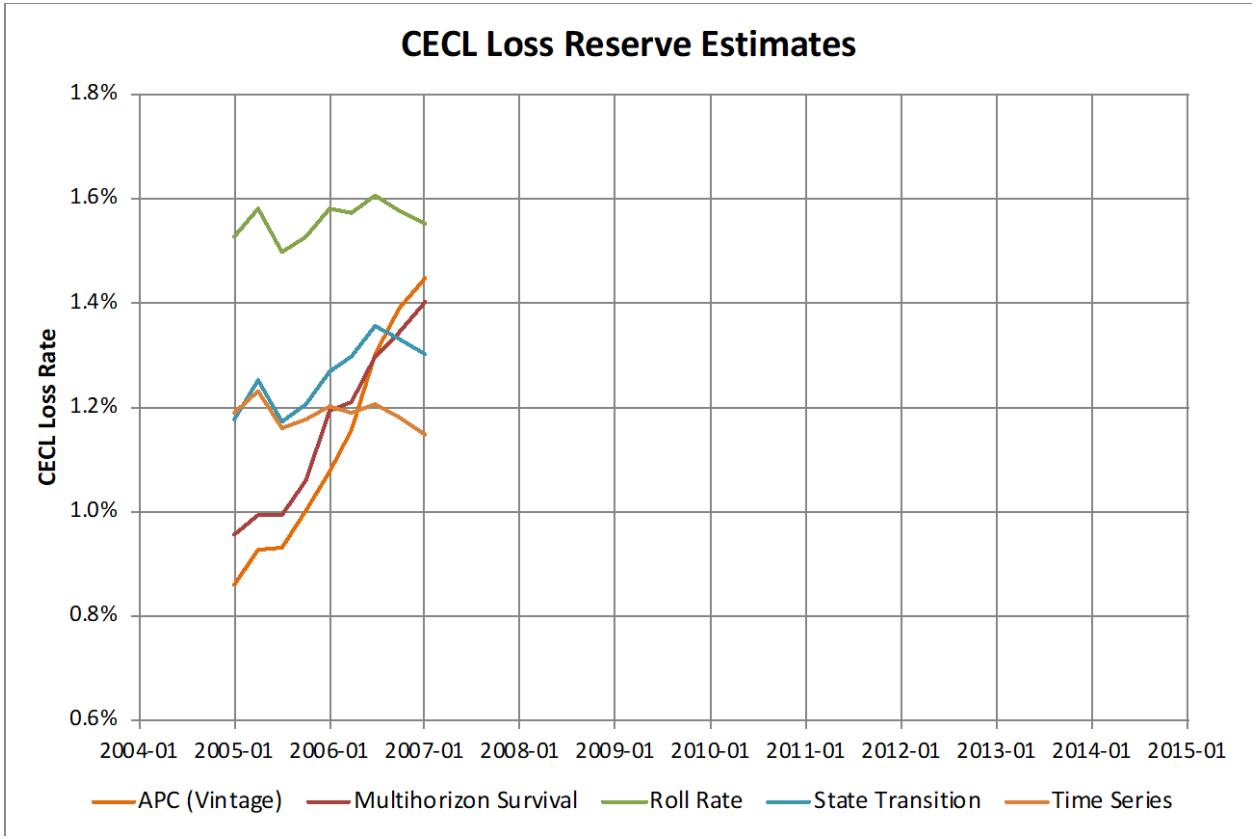
These are the consensus scenarios of 30 top economists through the last recession. All of the following results use these.

Model Forecasts



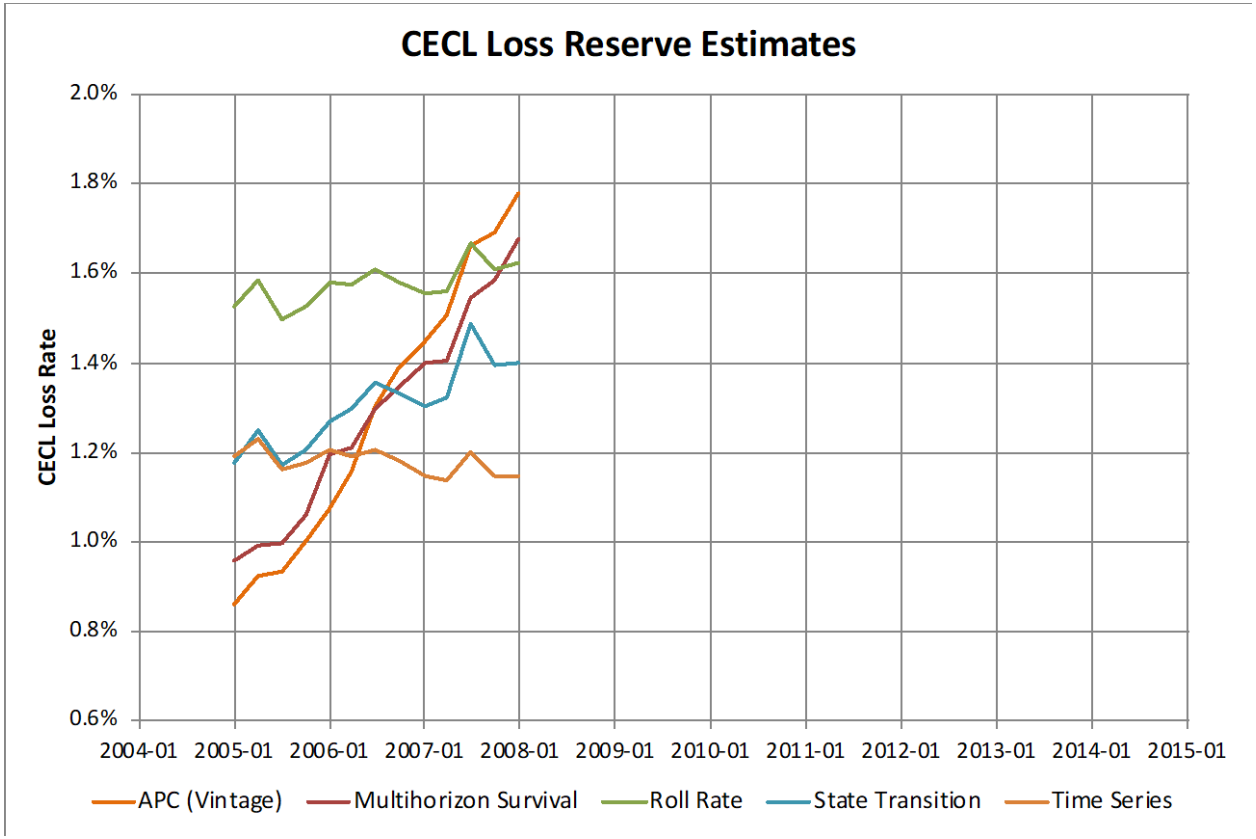
Forecasts each quarter using historical economic scenarios.

Loss Reserve Estimates on January 2007



Over the previous 24 m, loss reserve estimates rose from 0.9% to 1.4%, due to credit quality of recent vintages.

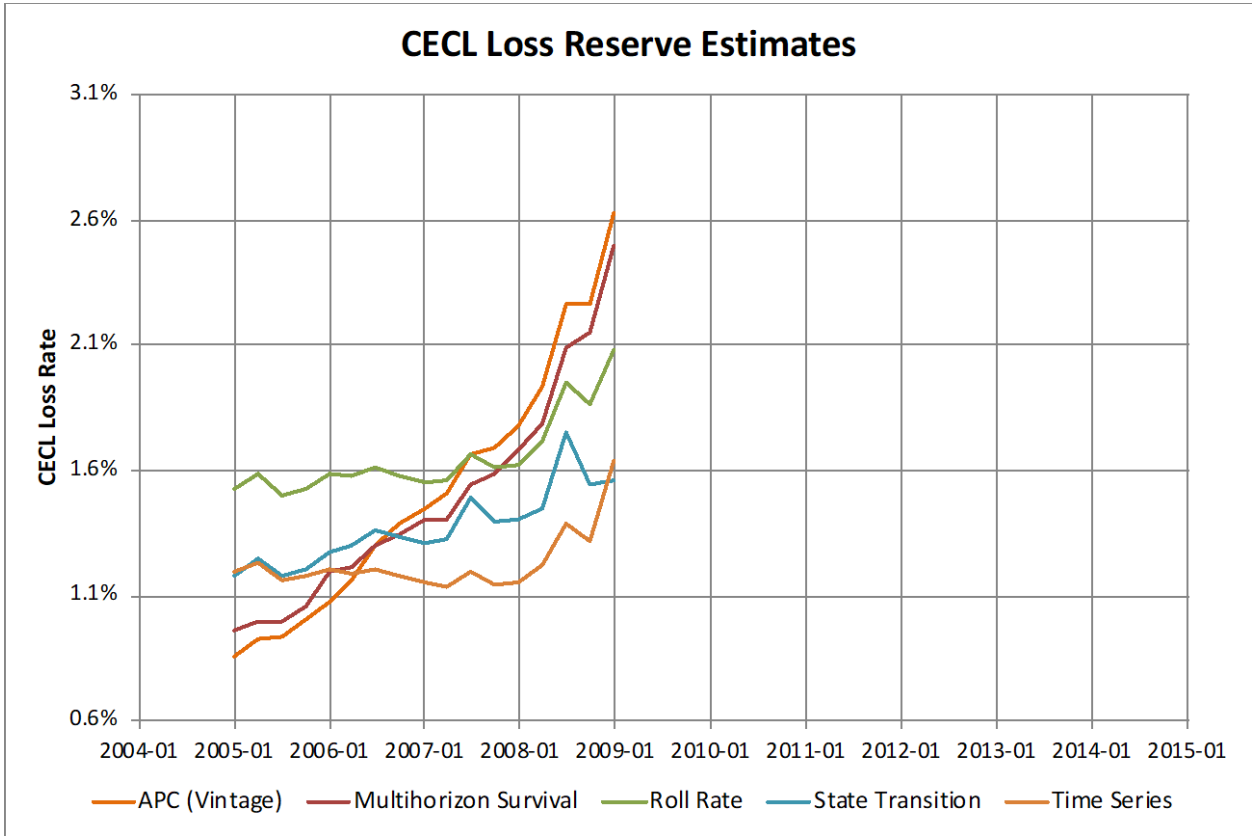
Loss Reserve Estimates on January 2008



Over a 3 year period, reserves according to APC and Multihorizon models increased 2x, because of credit quality.

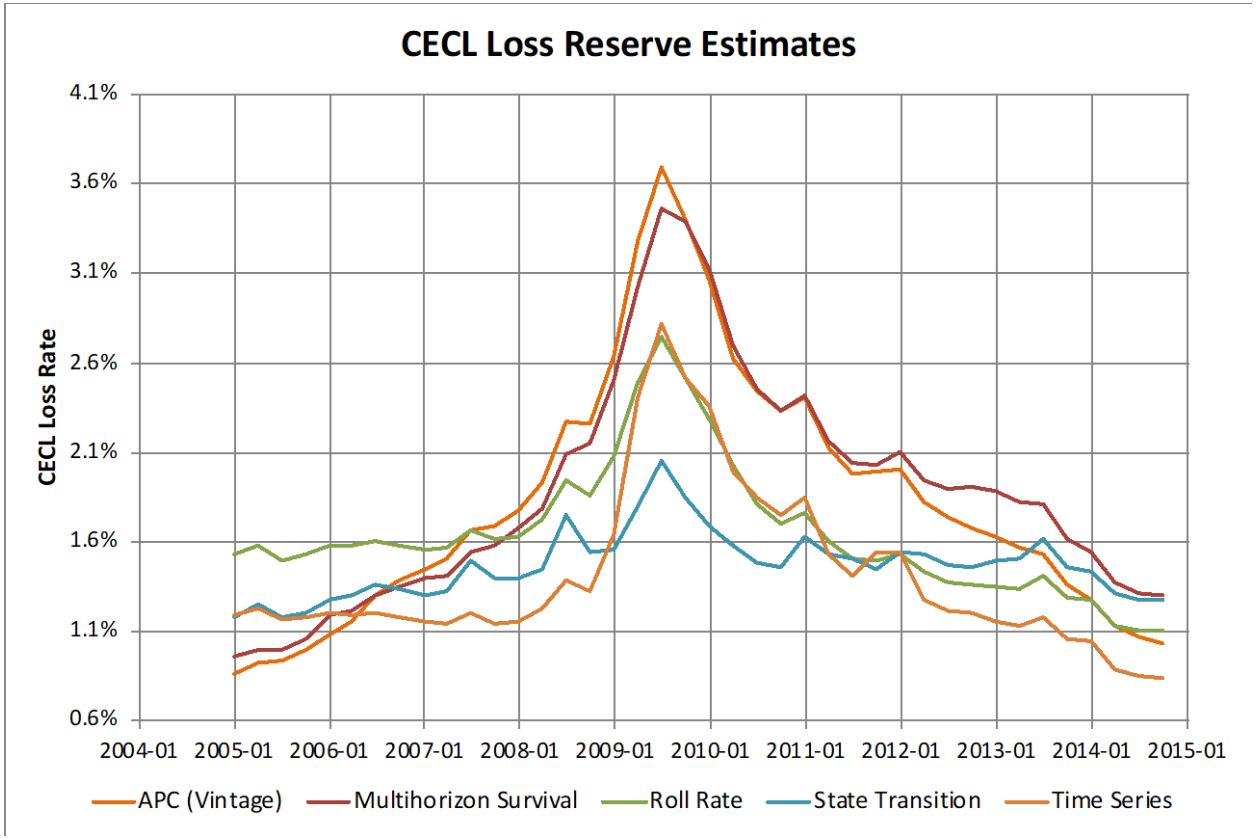
Reserves increased 20% with the State Transition model because of delinquency.

Loss Reserve Estimates on January 2009



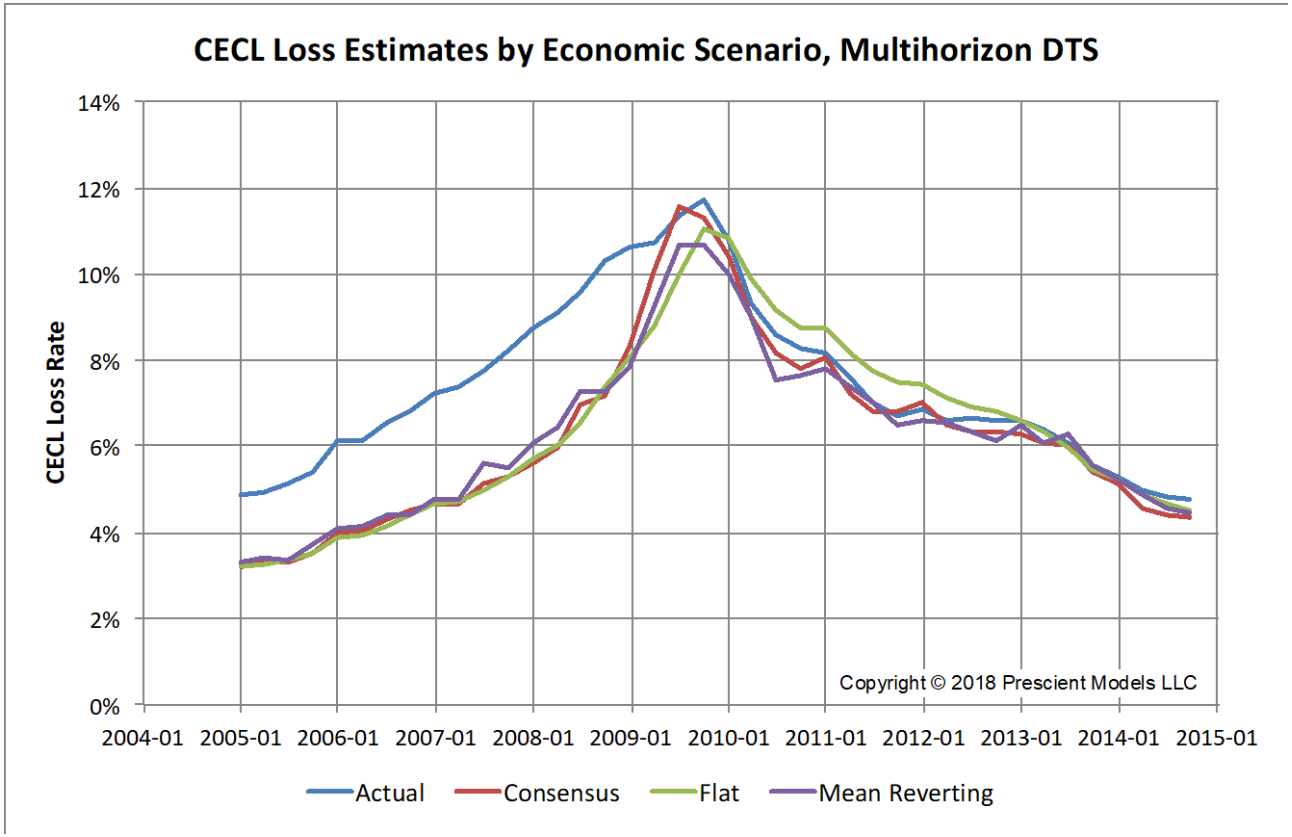
In the previous 12 m, unemployment rose from 5% to 8.5%, so increases seen here are a response to the recession.

Loss Reserve Estimates through the Cycle



Changes in reserves through the rest of the cycle are largely synchronized because they're driven primarily by economic conditions.

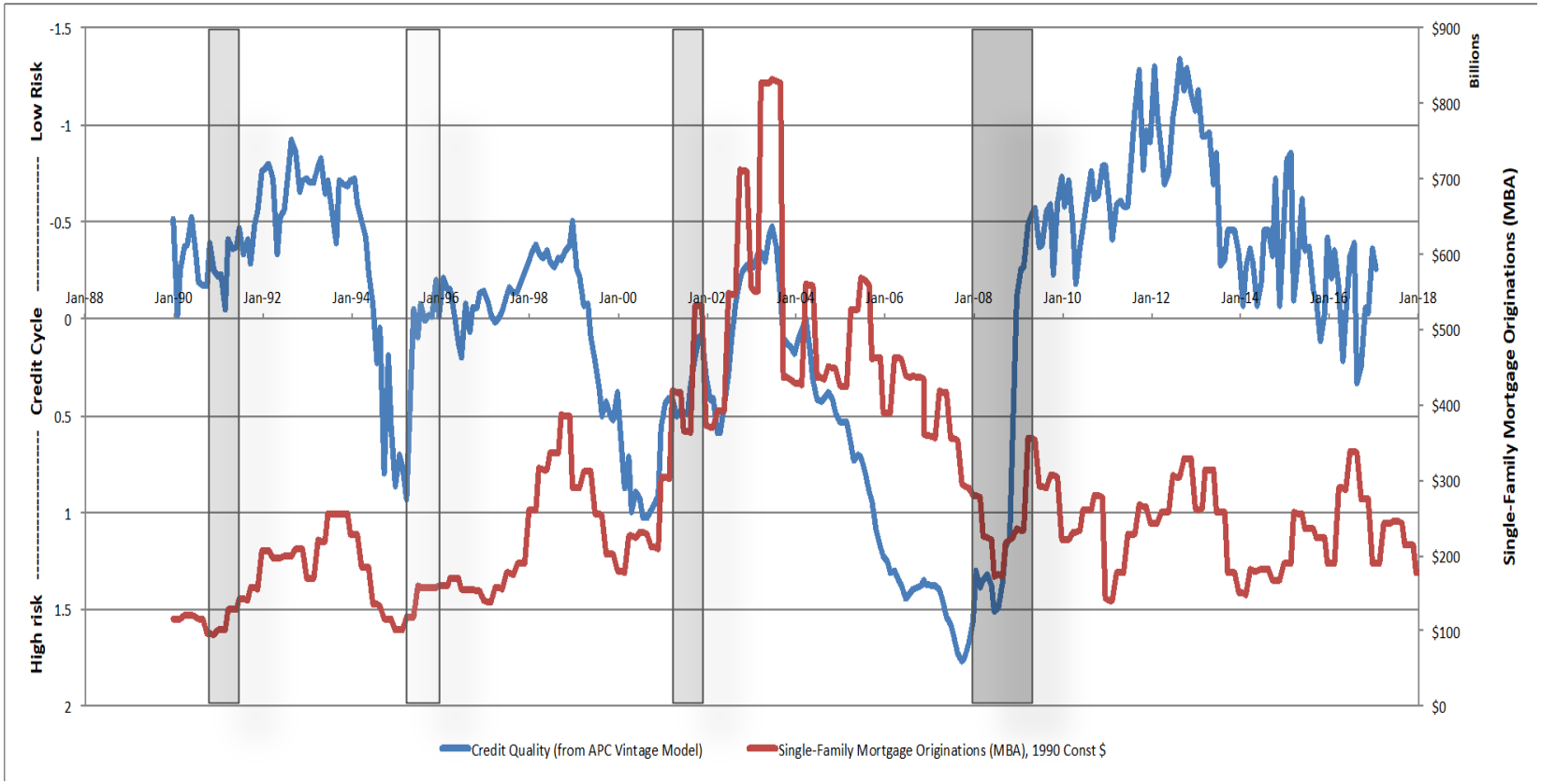
Comparing Different Economic Scenarios



Perfect foresight helps.

All other scenarios are essentially equivalent.

Credit, Origination, and Economic Cycles

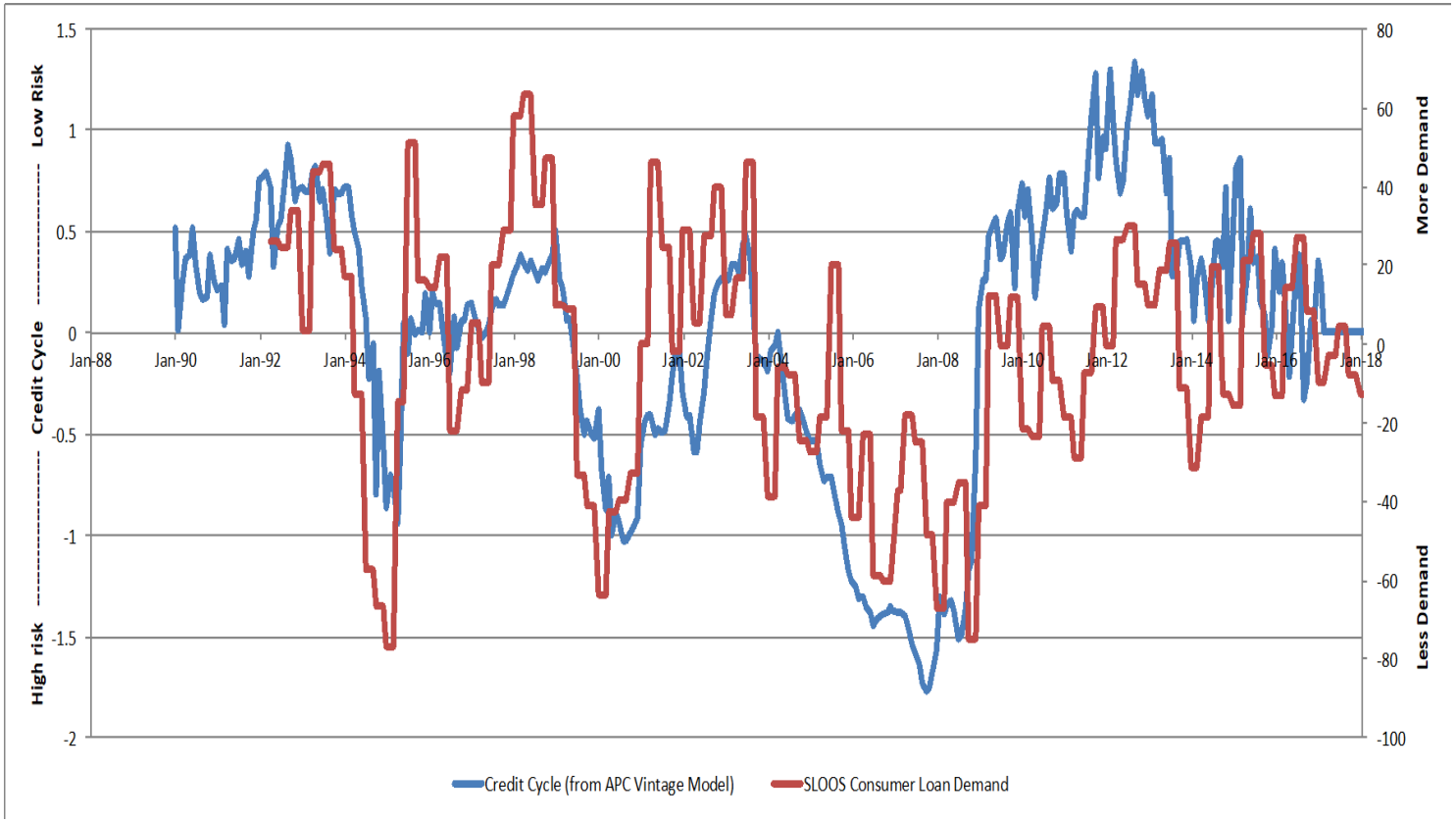


Blue line: Credit cycle as measured with an Age-Period-Cohort (Vintage) model applied to US mortgage performance.

Red line: Loan origination cycle. The volume of US mortgage originations in 1990 constant $.

Gray bars: Economic cycle as measured by change in Real GDP. Credit cycle leads economic cycle by an avg of 17 months.

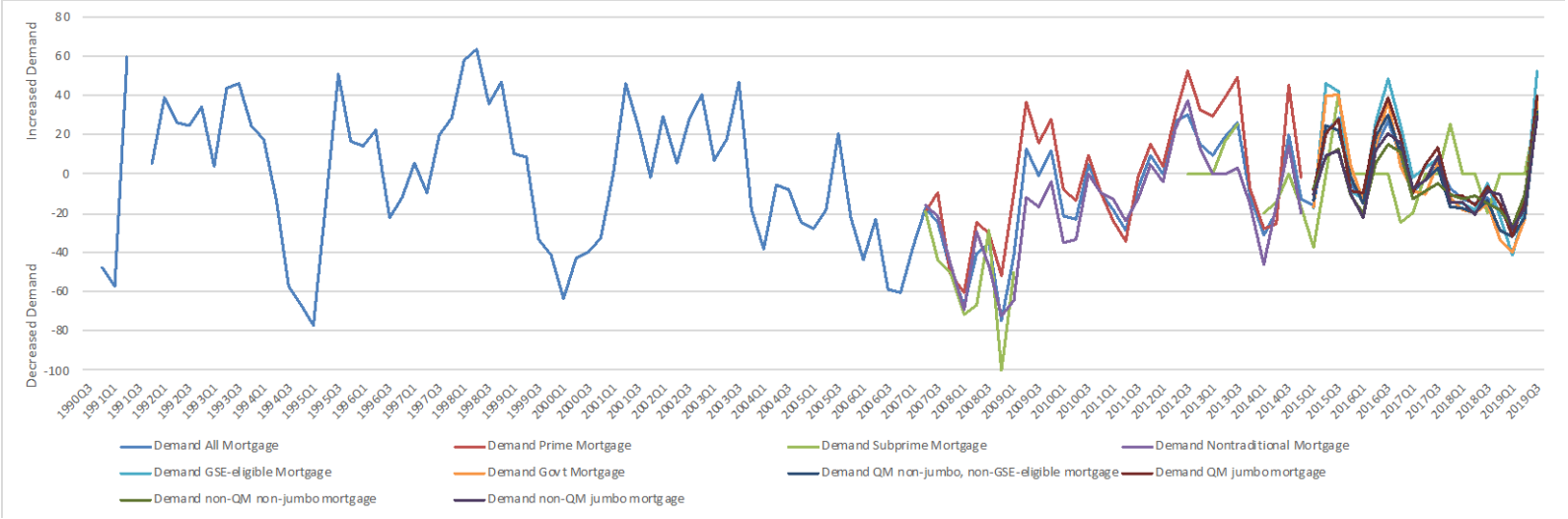
Credit Cycle vs. Loan Demand (SLOOS)

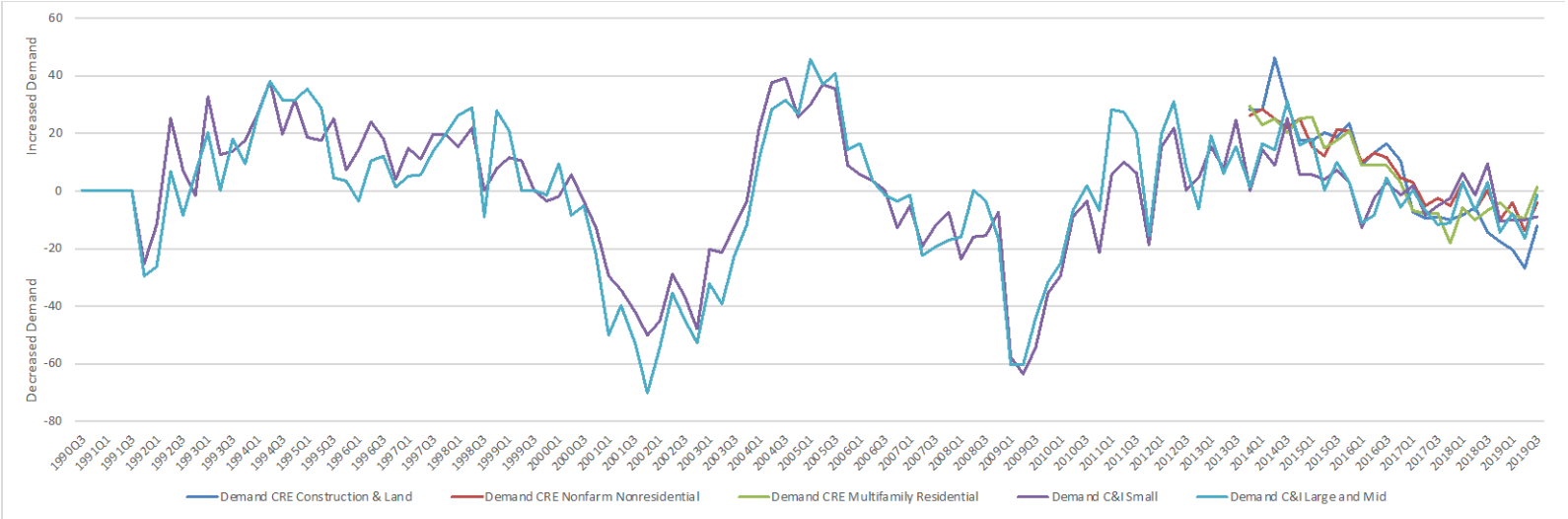


When loan demand is high, credit risk is low.

When loan demand is low, credit risk is high.

Current Loan Demand in the US





For more information

Joseph L. Breeden, PhD, CEO

breeden@prescientmodels.com

+1-505-670-7670

www.prescientmodels.com

Living with CECL: Mortgage Modeling Alternatives, 2018. Available on Amazon.com