



# CONSUMER RISK APPETITE, THE CREDIT CYCLE, AND THE HOUSING BUBBLE

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The views expressed in the paper are those of the authors and do not necessarily reflect the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System. We thank Sharon Tang for outstanding research assistance and to Amy Sill for outstanding logistic assistance. We wish to thank William W. Lang, Promontory Financial Group, LLC. for his many years of support and assistance on this project. Any errors or omissions are our own.

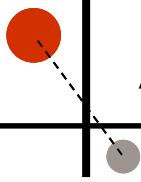




# Research Goals

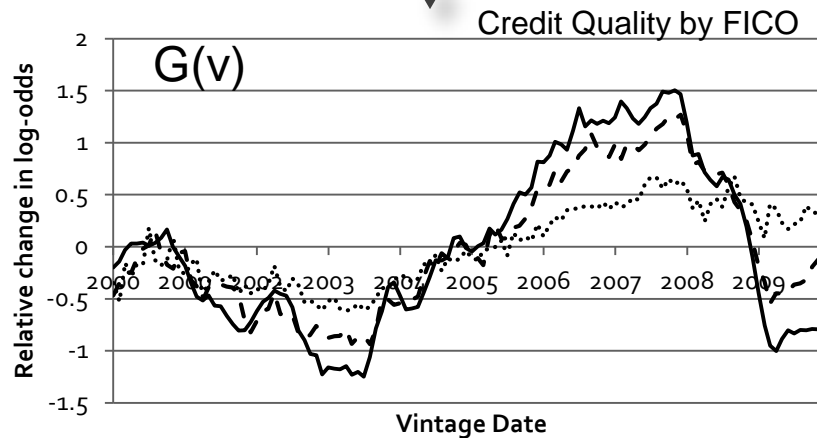
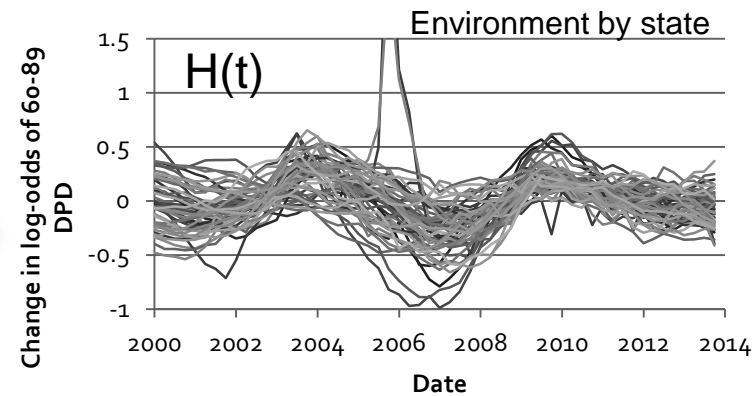
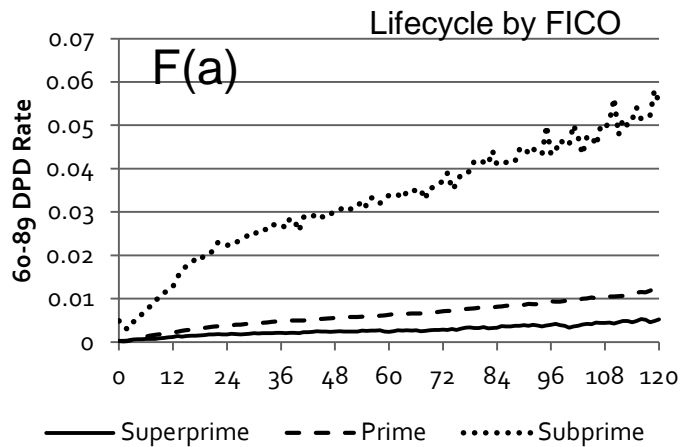
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- Study US mortgage performance data (LPS Applied Analytics data) to determine the role of changes in consumer risk appetite in the US Mortgage Crisis.
- Use a merger of Age-Period-Cohort Models (APC) and scoring to measure the component of loan performance not explainable by scoring factors, economic environment, or lifecycle.



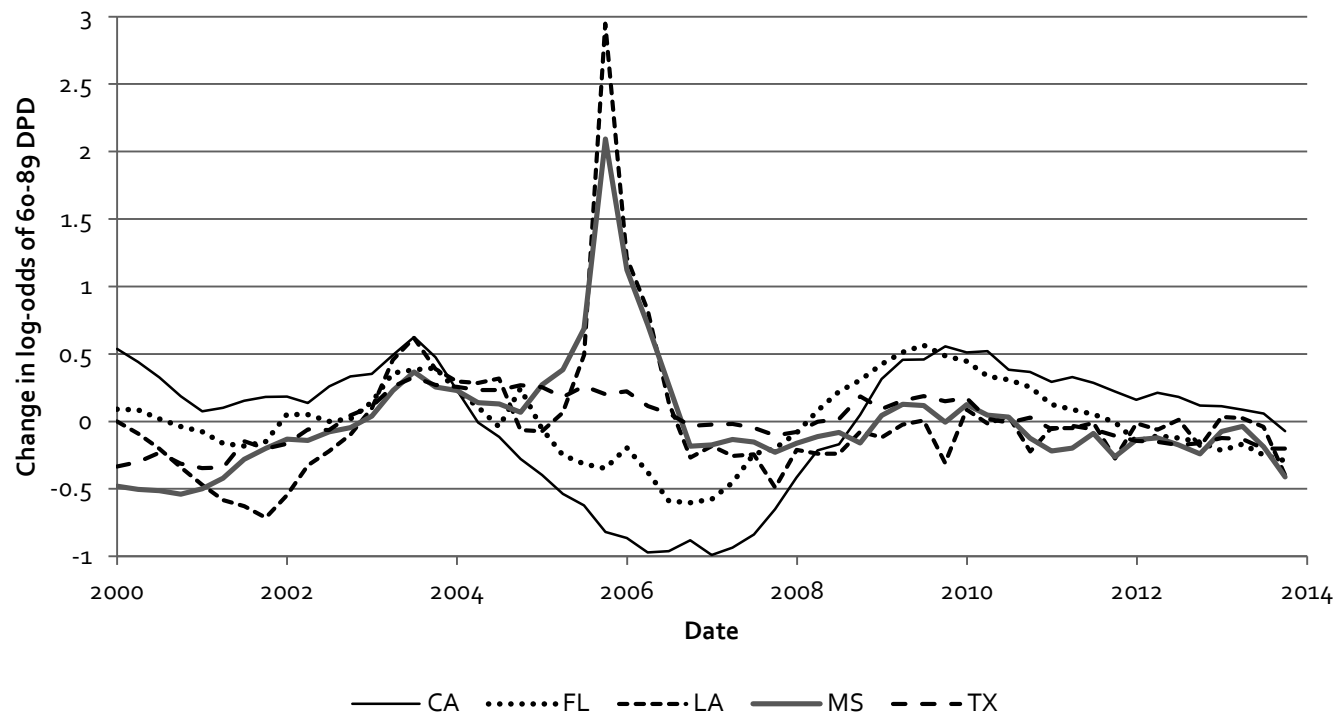
# Age-Period-Cohort Decomposition

$$\log\left(\frac{p(a,v,t)}{1-p(a,v,t)}\right) = F(a) + G(v) + H(t)$$



# Adjusting for the Environment

- Relying on the decomposition to adjust for the environment can be more effective than trying to include specific economic factors.
- The example below shows Hurricane Katrina's impact. Later results are normalized any environmental impacts, like those shown here.



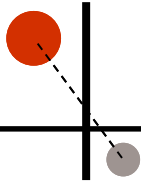


# Loan-level Modeling

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- We use an APC 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 include typical origination scoring factors and then test for the inclusion of vintage fixed effects (dummy variables).

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



# Scoring Factors

The origination scoring factors and coefficients were typical for 1<sup>st</sup> lien, fixed rate mortgages.

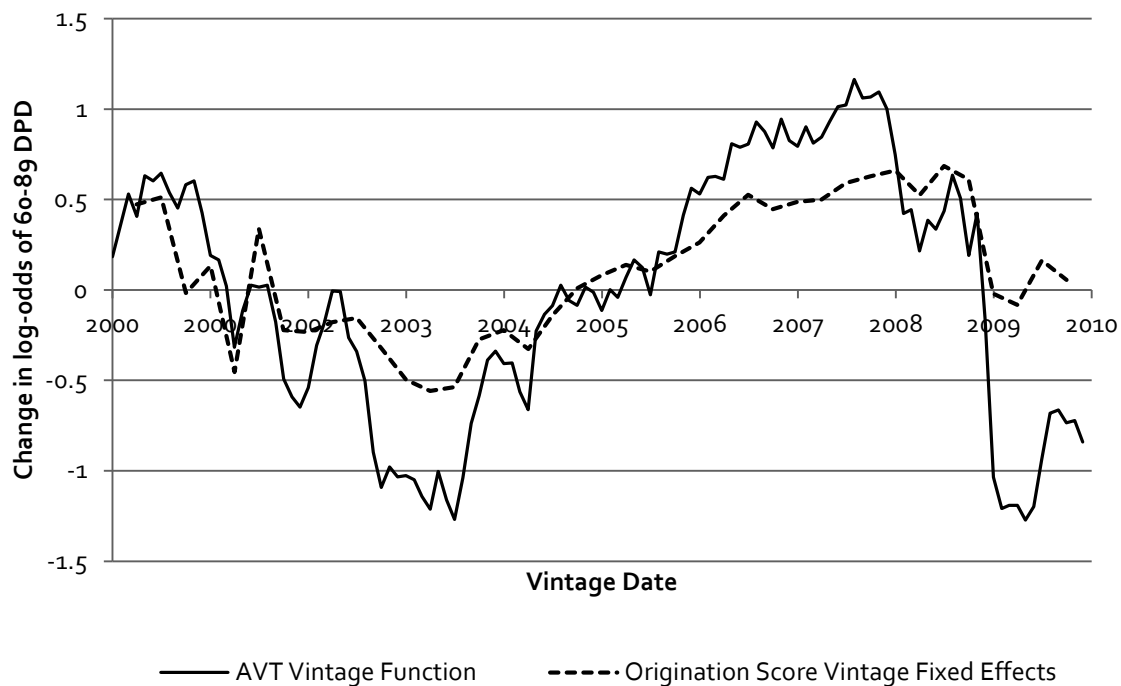
**Table 4: Output Coefficients from the GLM Analysis of Mortgage Delinquency.**

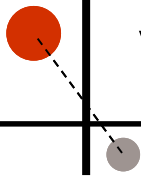
variables	Coef.	t-val	Variables (cont.)	Coef.	t-val
Intercept	2.268	67.83	<b>Source Channel</b>		
Jumbo Loan	-0.128	-16.57	source 1	0	
<b>Documentation</b>			source2	0.217	63.27
Full documentation	0		source7	0.100	30.25
Low documentation	0.103	25.48	sourceT	0.240	38.63
No documentation	-0.030	-5.16	sourceU	0.437	32.19
Documentation unknown	0.135	40.61	<b>Occupancy</b>		
<b>Fico at Origination</b>			Owner	0	
up to 540	0		Non-owner	-0.109	-17.75
540 to 580	-0.188	-17.33	Other or Unknown	-0.187	-17.84
580 to 620	-0.435	-44.66	<b>PMI</b>		
620 to 660	-0.807	-85.86	No	0	
660 to 700	-1.373	-145.22	Yes	0.119	32.06
700 to 740	-1.956	-202.66	Unknown	0.170	37.92
740 to 780	-2.671	-264.46	<b>Term</b>		
780 to 820	-3.380	-283.96	0 to 120	0	
820+	-3.623	-52.71	120 to 180	0.144	10.39
<b>Loan to Value</b>			180 to 240	0.407	27.38
0 to 0.75	0		240 to 360	0.593	44.05
0.75 to 0.8	0.157	40.09	360+	0.640	36.25
0.8 to 0.85	0.221	46.80	<b>Purpose</b>		
0.85 to 0.9	0.247	42.01	Purchase	0	
0.9 to 0.95	0.262	42.53	Refinance	-0.001	-0.41
0.95 to 1	0.305	46.79	purposeU	-0.462	-64.29
1 to 1.13	0.285	36.81	purposeZ	0.090	5.08
DTI	0.007	73.35			

Note: The model specification includes also quarterly vintage dummies that are not explicitly reported in this table.

# APC Vintage Function versus Scoring Vintage Dummies

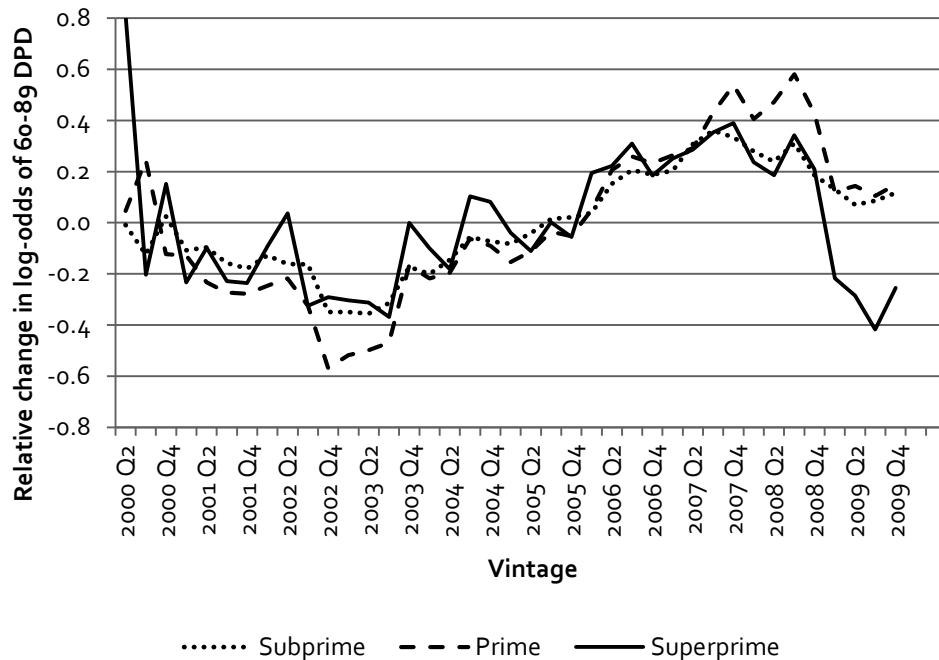
- The APC vintage function measures the net impact to log-odds of default for the variation in credit risk by vintage.
- The scoring vintage dummies measure the vintage residual after scoring factors.
- By comparing, we see that only half of the vintage variation is explainable by scoring factors.





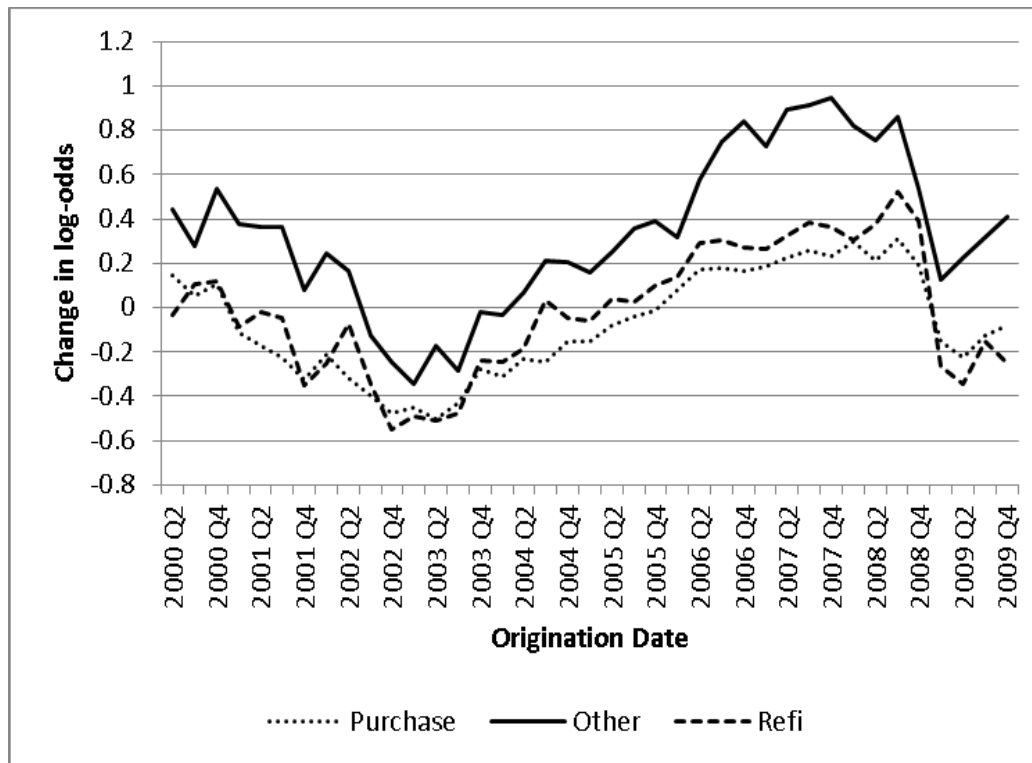
# Vintage Fixed Effects by Score

We performed the scoring analysis separately for subprime, prime, and superprime. In each case, the vintage fixed effects were a significant contribution to the models and of roughly equal contribution.



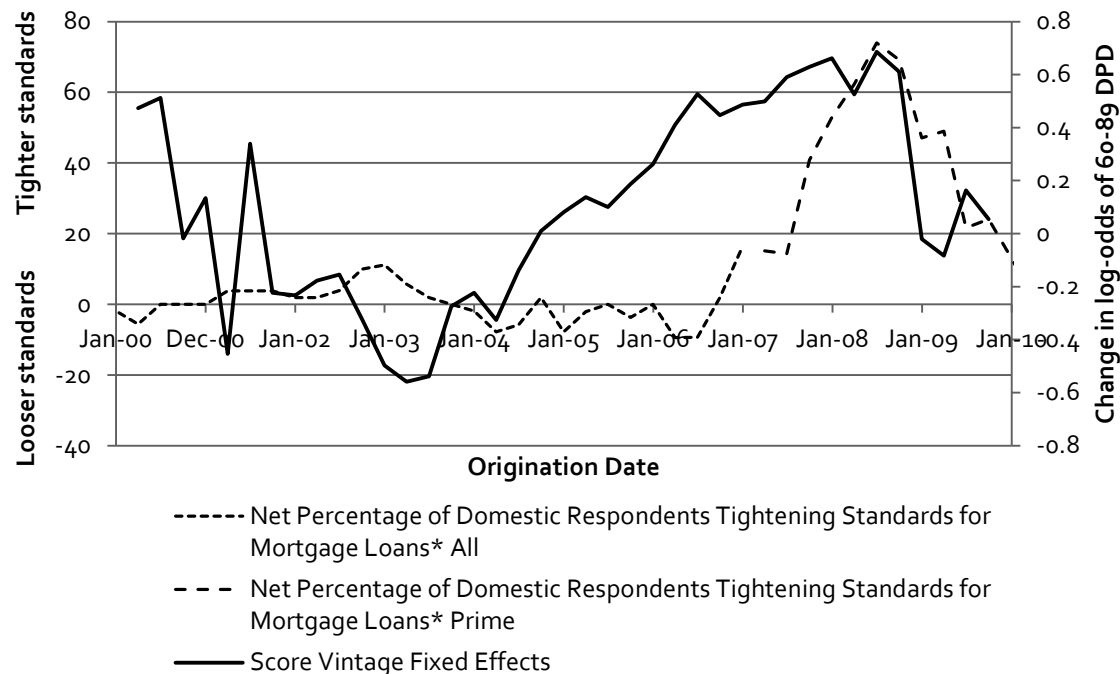
# Vintage Fixed Effects by Purpose

When segmented by purpose, the variation in unexplained vintage risk as measured by the fixed effects is still roughly the same. (Level shifts are not important for this analysis.)



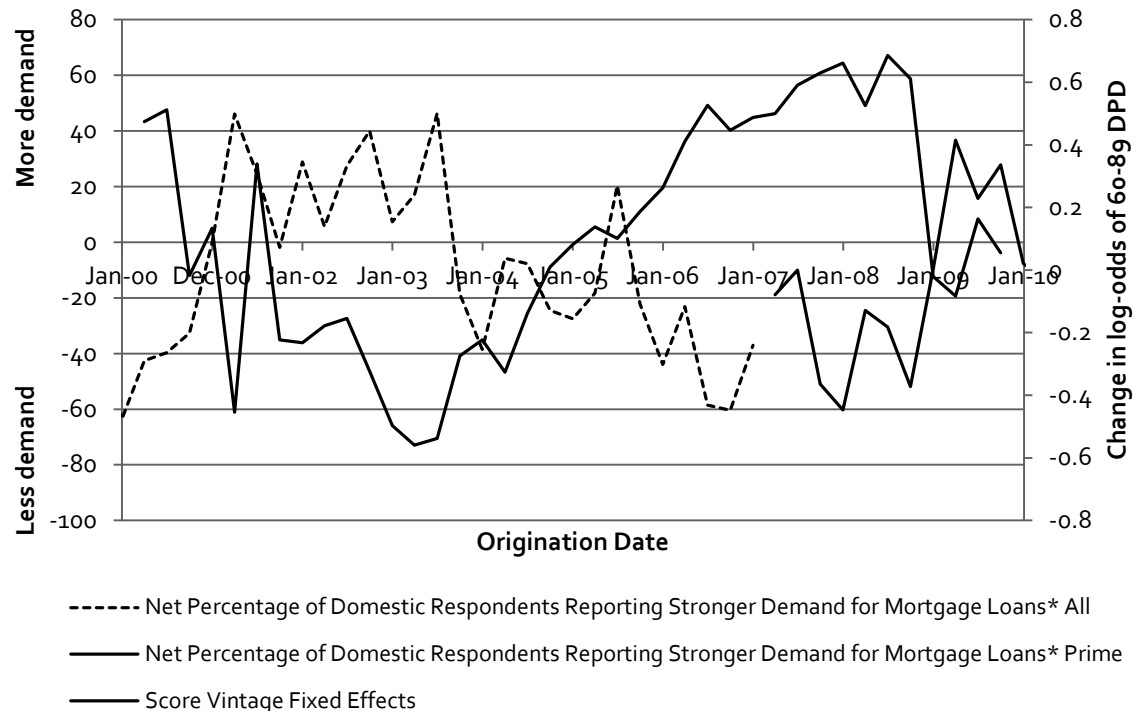
# FRB SLOOS Survey – Underwriting Standards

- The Federal Reserve publishes a Senior Loan Officer Opinion Survey (SLOOS).
- Self-reported changes in underwriting standards show a correlation of  $\rho = 0.4 \pm 0.4$  to the vintage fixed effects, with the wrong sign.



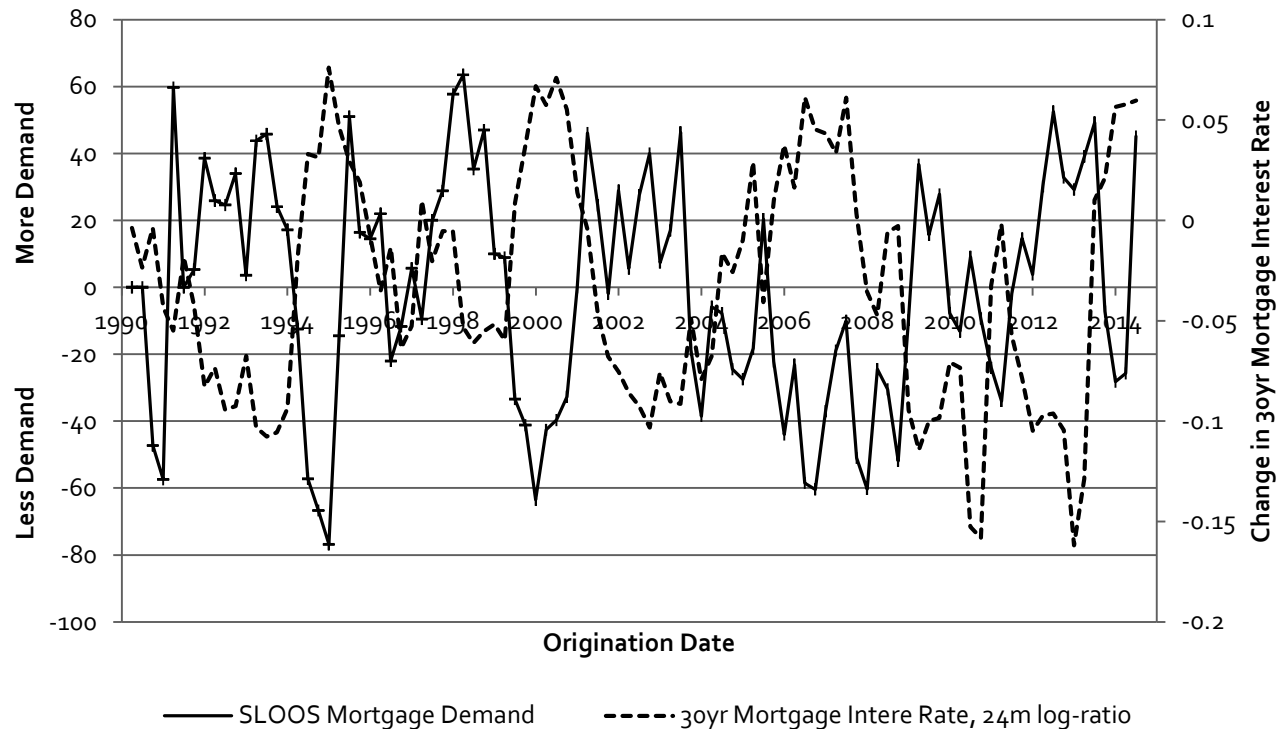
# FRB SLOOS Survey – Consumer Loan Demand

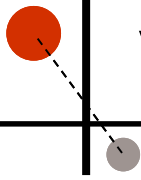
- The same senior loan officers in the same survey report on consumer demand for loans.
- Consumer demand has a correlation of  $\rho = -0.7 \pm 0.3$  to the vintage effects.
- When consumer demand is high, the loans are good – consumer risk appetite is a real driver of credit risk.



# Drivers of Consumer Demand

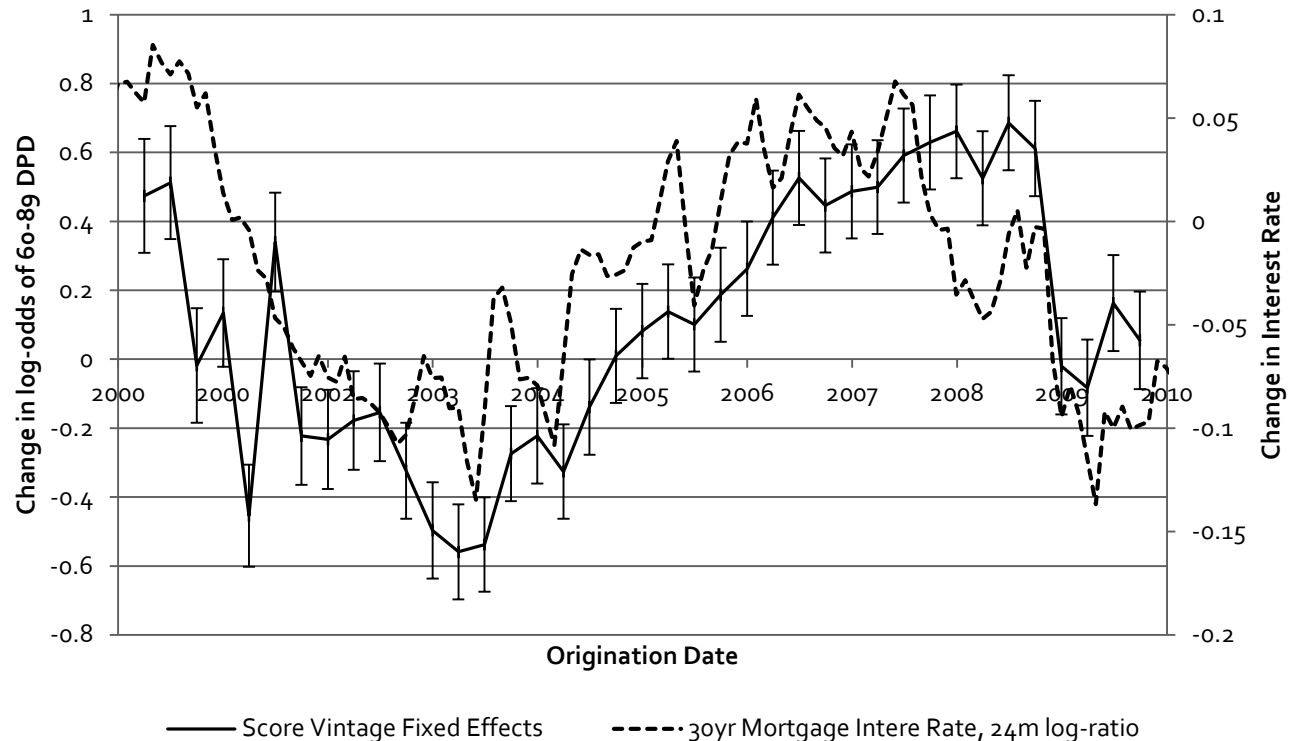
- Historically, SLOOS-reported consumer mortgage demand is highly correlated to the 24-month change in mortgage interest rates.
- When offered interests fall over a sustained period, consumer demand rises.





# Vintage Fixed Effect Correlations

- The vintage fixed effects measured from our score are highly correlated to the 24-month change in offered interest rate at the time the mortgage was booked.





# Conclusions

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- Typical scoring attributes explain only half of the vintage quality variation observed through the US Mortgage Crisis.
- Vintage fixed effects measured after adjusting for lifecycle, environment impacts, and scoring attributes correlate well to consumer demand and 2-yr changes in mortgage interest rates at the time of origination.
- Interpretation: Fiscally conservative consumers are dynamic in their borrowing habits. They are in the market only when the environment is favorable. This variation in consumer risk appetite, or macroeconomic adverse selection, was a significant contributor to the crisis.