

The Failure of Supervisory Stress Testing: Fannie Mae, Freddie Mac, and OFHEO

W. Scott Frame*

Federal Reserve Bank of Atlanta

[Joint with Kris Gerardi and Paul Willen]

Bank of Italy

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*The views expressed here are my own and not necessarily those of the Federal Reserve System.

Introduction

After the financial crisis, regulatory authorities around the world adopted stress testing as a central tool for supervising large complex financial institutions, calibrating capital standards, and promoting financial stability.

Stress testing may confer benefits, including enhanced risk measurement and management at covered institutions and supervisory learning about the firms and system-wide vulnerabilities.

But stress tests are vulnerable to several “model risks” arising from stress scenario design, data, empirical model specification, estimation frequency, forecast horizon, and treatment of new business.

Notably, the one pre-crisis attempt by U.S. supervisors to use stress testing for setting risk-based capital charges was a spectacular failure.

- Office of Federal Housing Enterprise Oversight’s (OFHEO’s) risk-based capital stress test for Fannie Mae and Freddie Mac (Fannie & Freddie).

Introduction

Fannie & Freddie are “government-sponsored enterprises” (GSEs) that are central to the U.S. housing finance system. They each operate two core businesses:

- Issue credit guarantees on mortgage-backed securities (MBS).
- Finance MBS and whole mortgage loans on-balance sheet.

GSEs are quasi-public/quasi-private institutions – chartered by the U.S. Congress.

- Fannie & Freddie were immensely politically powerful before the crisis.

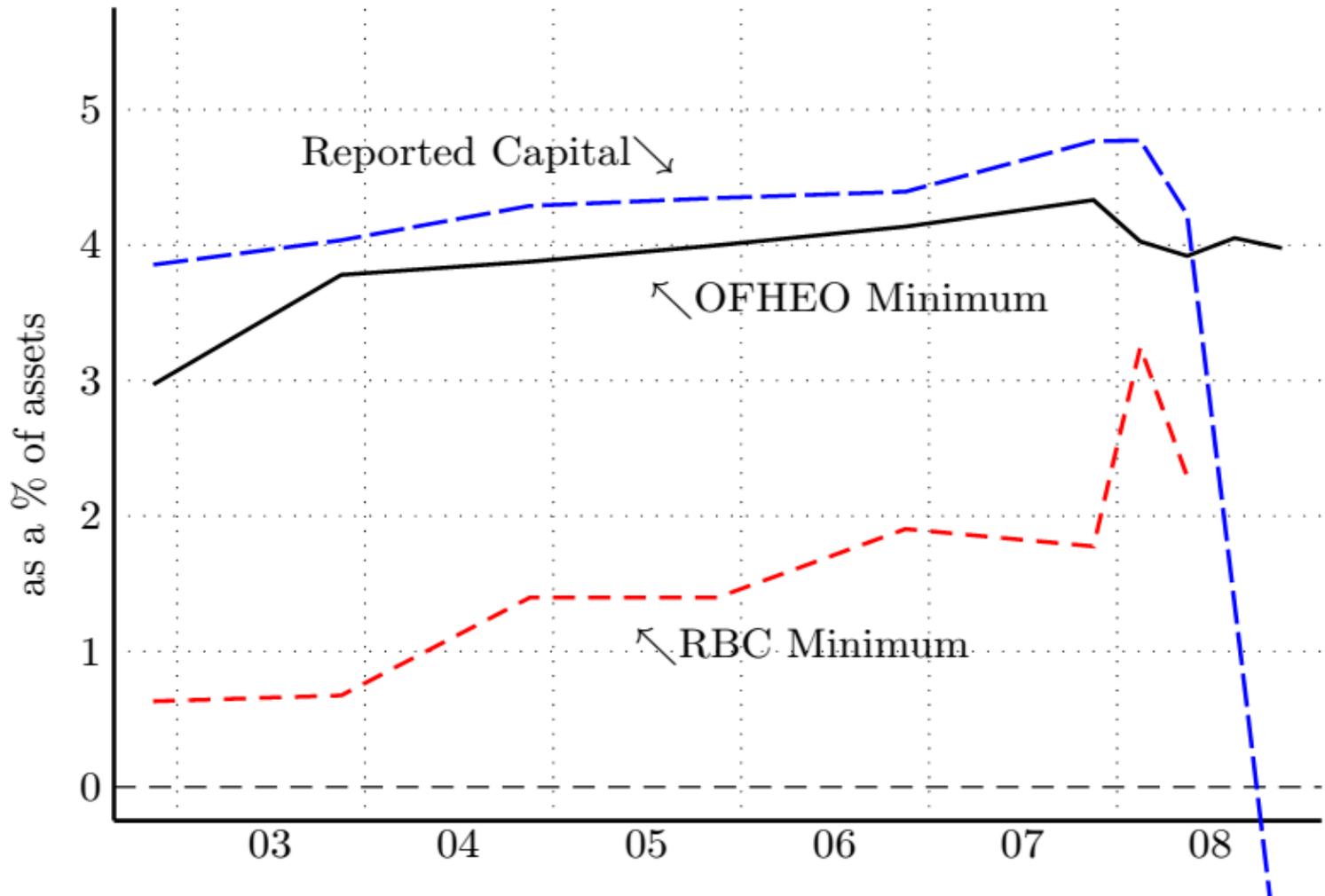
Fannie & Freddie became financially distressed and were placed in federal conservatorship in September 2008; ultimately received \$187.5 billion from the U.S. Treasury. Largest individual bailouts of the financial crisis.

Fannie & Freddie were subject to two OFHEO-enforced capital requirements.

- Statutory minimum capital requirement: 2.5 percent of on-balance sheet assets plus 0.45 percent of off-balance sheet credit guarantees.
- Risk-based capital requirement based on OFHEO-constructed stress test.

Reported levels of capital for both GSEs exceeded the minimum requirement -- and widely exceeded the risk-based requirement – for each of the 24 quarters that the risk-based capital rule was in-force (2002:Q3 – 2008:Q2).

OFHEO Required Capital: Freddie Mac



Risk-Based Capital Rule

OFHEO's risk-based capital rule was designed to ensure that Fannie & Freddie could maintain positive capital throughout a 10-year period of credit and interest rate stress and assuming no new business (i.e., run-off).

- Credit stress based on a past regional house price decline extrapolated across U.S.
- Two interest rate paths (up and down) which affect the timing of cash flows through prepayments/refinancing.

The stress test was constrained in some important ways by the enabling statute.

- Overall treatment of credit, market, and operational risks.
- Notice and comment requirements; full disclosure for replicability (i.e., parameters published in regulation and never updated).

Our paper studies the sources of failure within the risk-based capital stress test for Fannie & Freddie – specific focus on 30-year fixed-rate mortgage (FRM) performance.

- OFHEO's stress test models/parameters in the public domain.
- FRM's about 75% of the GSEs' combined book-of-business and most of their losses.
- Large loan-level datasets and a well-developed research methodology exists for model specification and estimation.

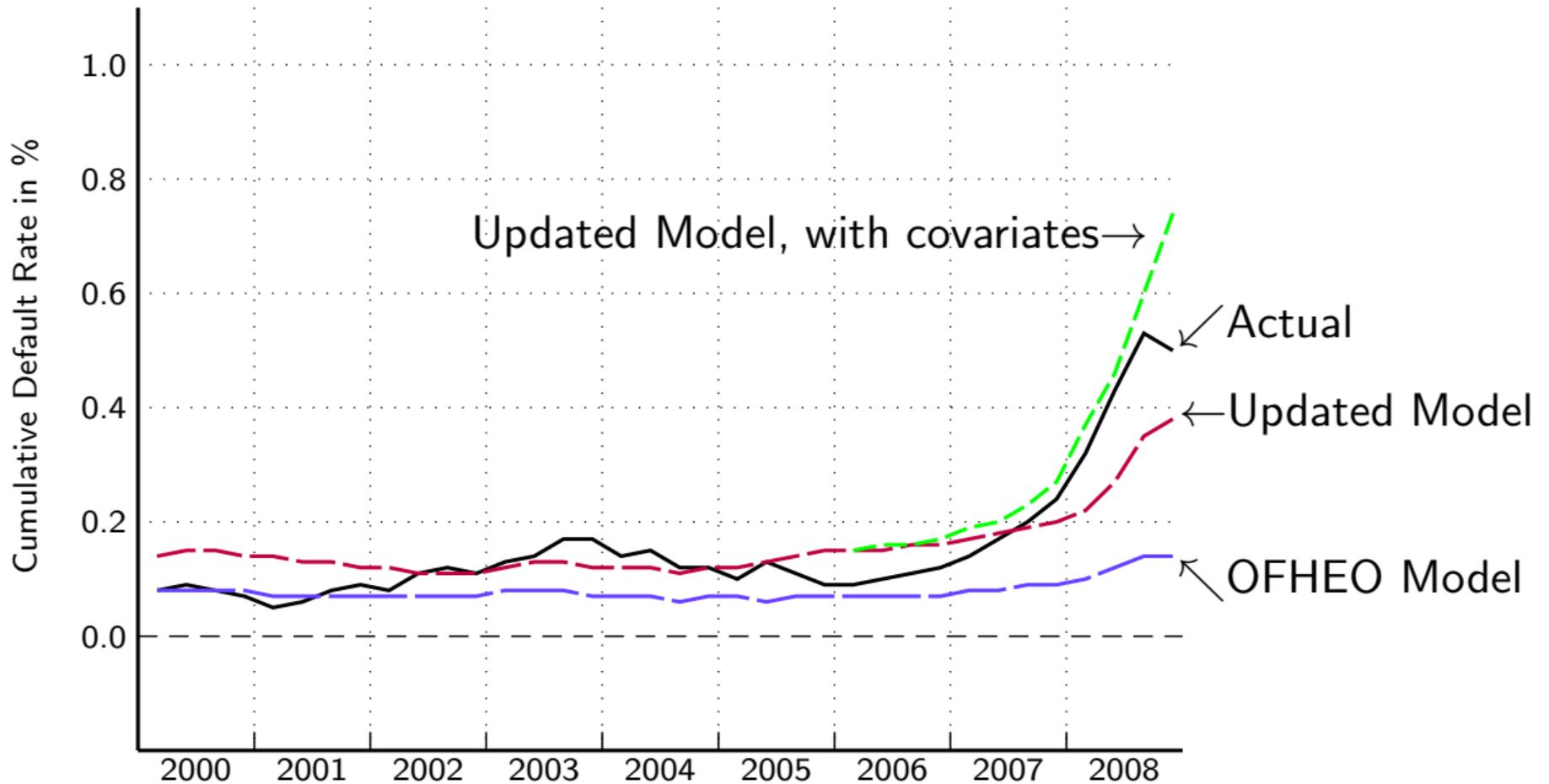
Model Estimation

We estimate three empirical models for 30-year FRM default and prepayment and then compare out-of-sample forecasts to realized values, assuming perfect foresight about quarterly house prices and interest rates.

- 1.) Published version of the OFHEO model (“static” OFHEO model) – baseline.
- 2.) Re-estimated OFHEO model using rolling regressions (“updated” OFHEO model).
 - Dramatically reduces forecast error versus static model.
 - Generates a sharp increase in expected defaults moving into the housing bust (with a lag).
 - Improvement in predictability comes from evolution of parameter estimates – especially high loan-to-value mortgages.
- 3.) Re-estimated OFHEO model using rolling regressions and additional underwriting variables, such as credit scores and documentation levels (“additional covariate” model).
 - Further improves default forecasts.

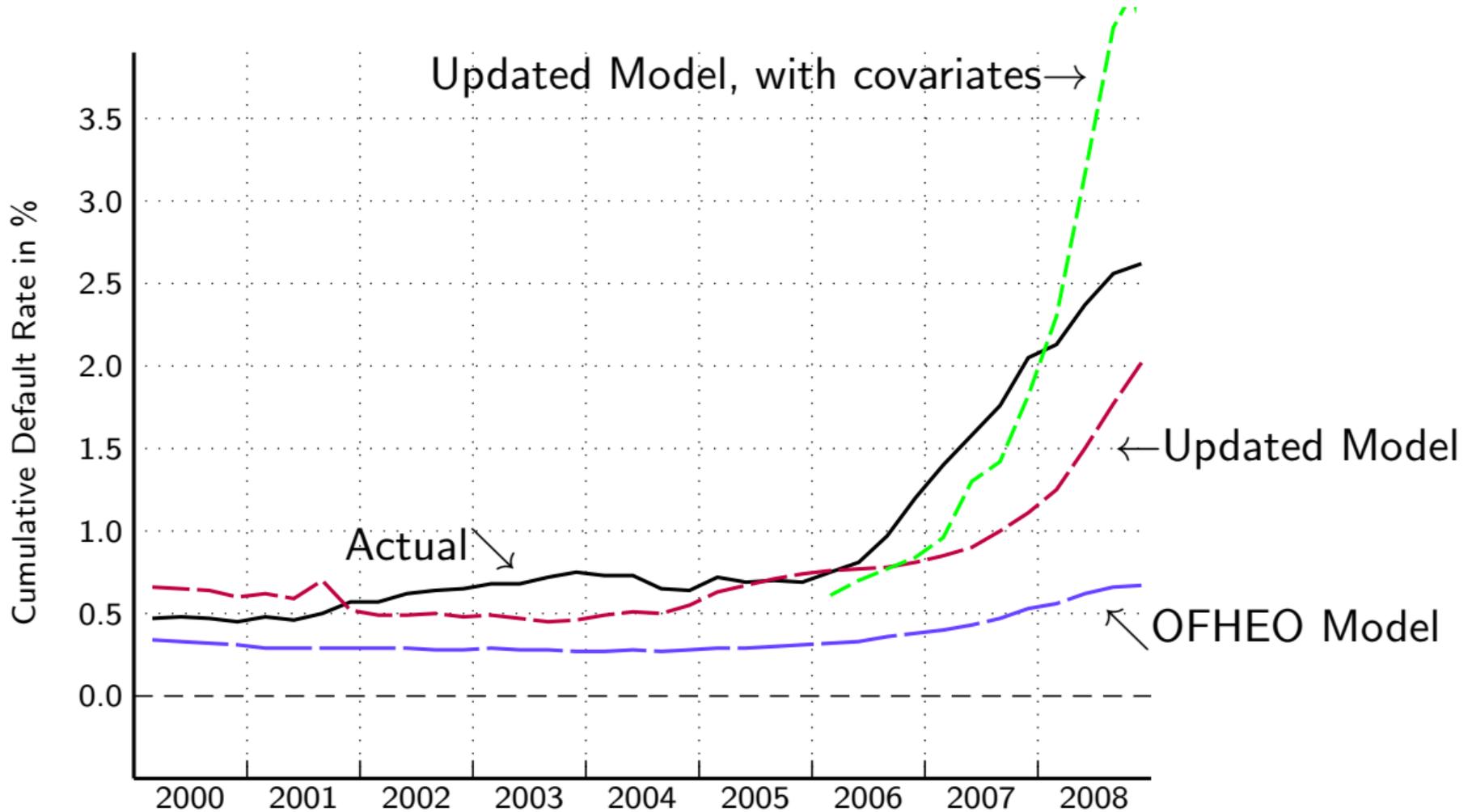
30-Year FRM Default Model Performance Comparison

1-Quarter Horizon



30-Year FRM Default Model Performance Comparison

2-Year Horizon



Risk-Based Capital Calculation

Investigate how model updating would have affected these requirements and whether this could have provided OFHEO with an early warning about the GSEs' financial condition.

We cannot fully replicate the actual risk-based capital requirements.

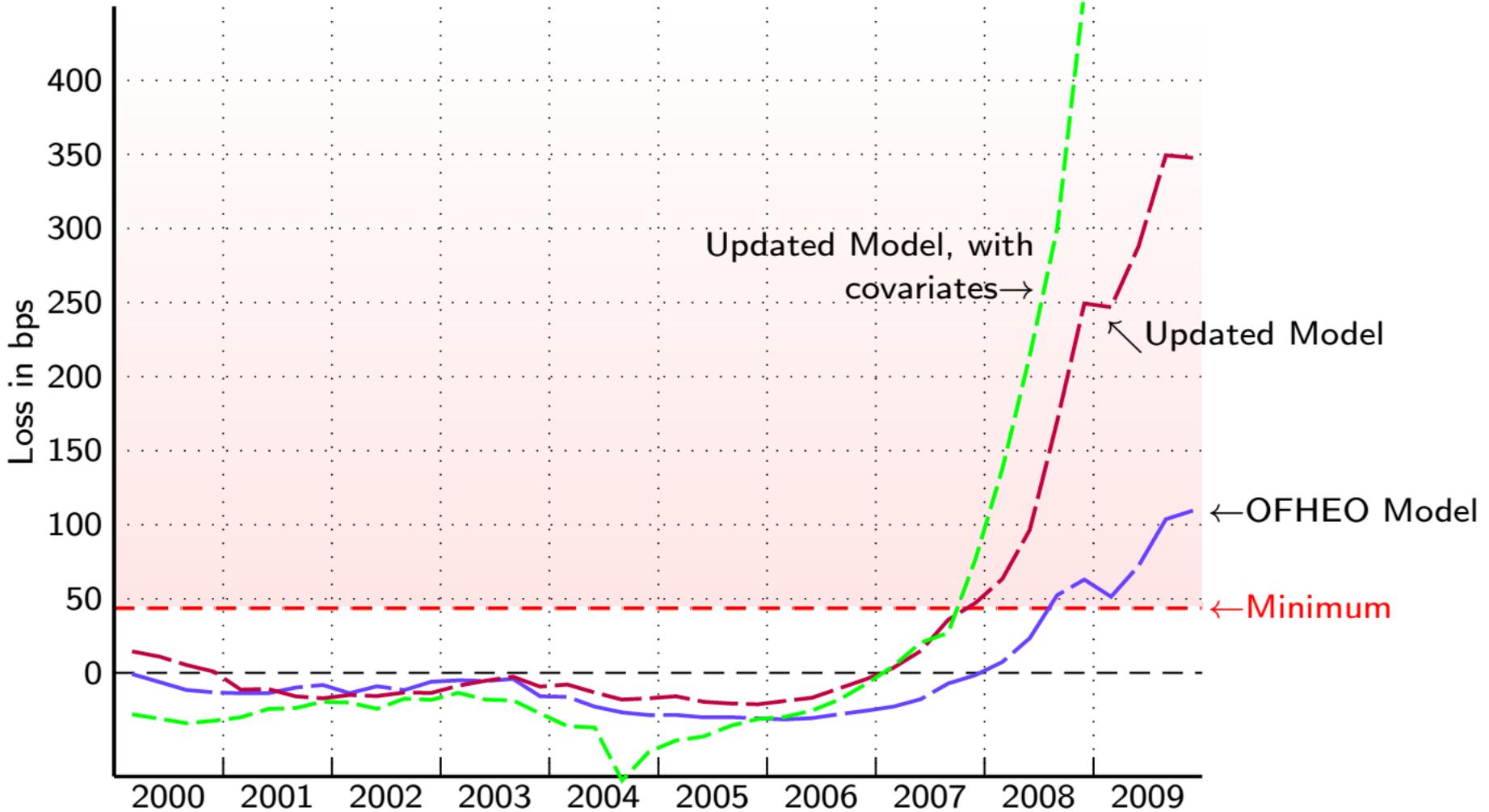
- Calculated using entire balance sheets and all off-balance sheet exposures.
- We focus on risk-based charges 30-year FRMs and compare to the 45 basis point statutory minimum capital standard for such risk.

For every quarter, create 10-year cumulative default and prepayment forecasts using OFHEOs house price and interest rate stress scenarios and assuming no new business (i.e., portfolio run-off) as in the rule.

- Project quarterly net income and discount cash flows to estimate required risk-based capital. Assumptions about loss severities, discount rates, capital distributions, etc. as in rule.
- Express gains/losses as a percentage of the total unpaid principal balance of GSE 30-year FRM holdings in a given stress test quarter.
- Compare to 45 basis point statutory minimum capital charge.

Risk-Based Capital Calculation

Panel A: OFHEO House Price Scenario



Risk-Based Capital Calculation

Static Model: Estimated losses do not appear until 2008:Q1 and do not surpass 45 basis points until 2008:Q3 (conservatorship).

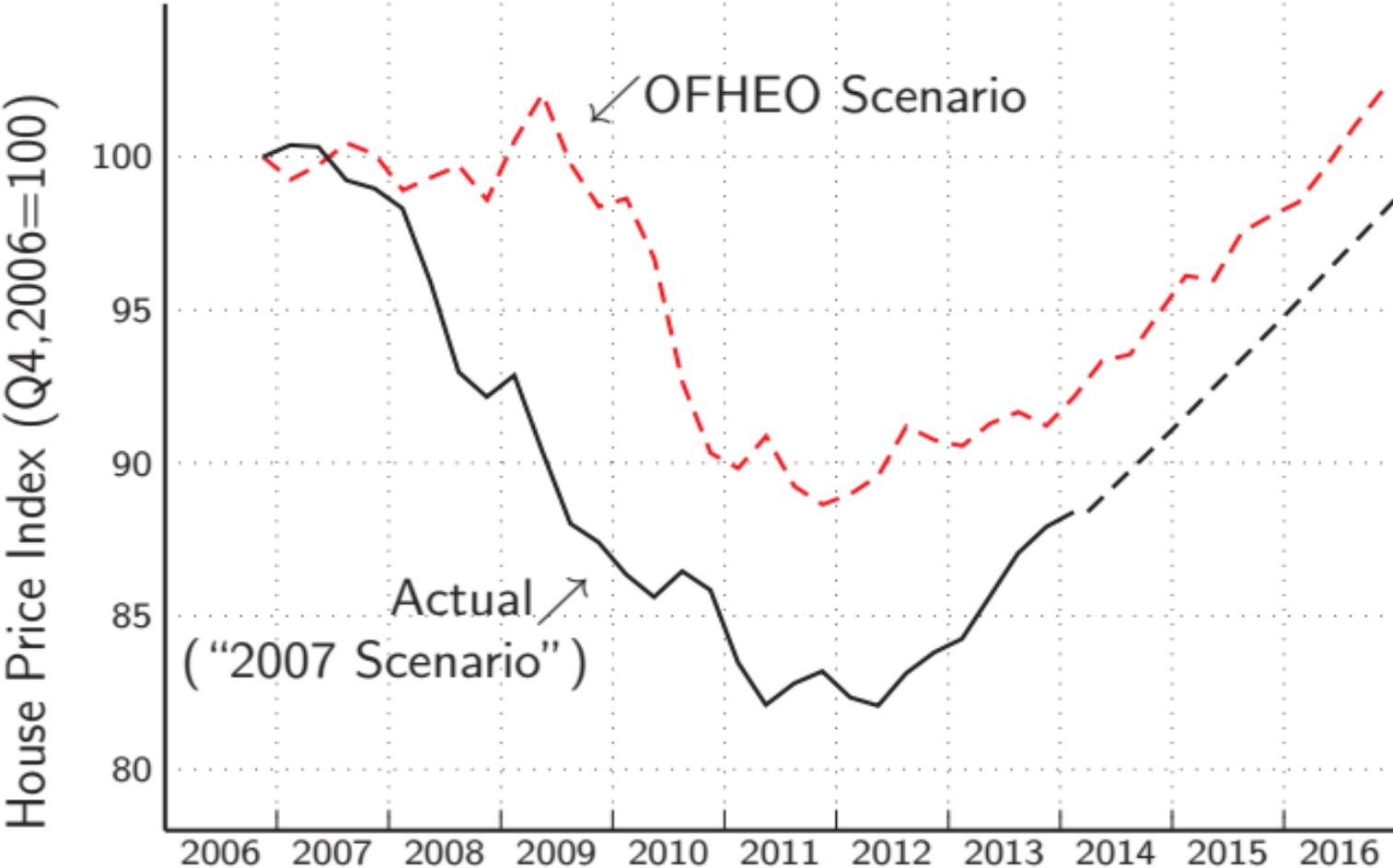
Updated Model: Estimated losses appear in 2007:Q1 and rise above the statutory minimum in 2007:Q4. This is consistent with the large difference in default forecasts between the “static” and “updated” models that emerges in late-2006.

Additional Covariates: Losses start to accrue as of 2006:Q3 and reach the statutory minimum in 2007:Q2. Would have generated expected losses of 370 basis points by the time of conservatorship.

Take-away: Simple model updating and enhancement would have likely provided OFHEO with a much earlier warning of the increased credit risk associated with the GSEs’ 30-year fixed-rate mortgage portfolio as the housing market turned.

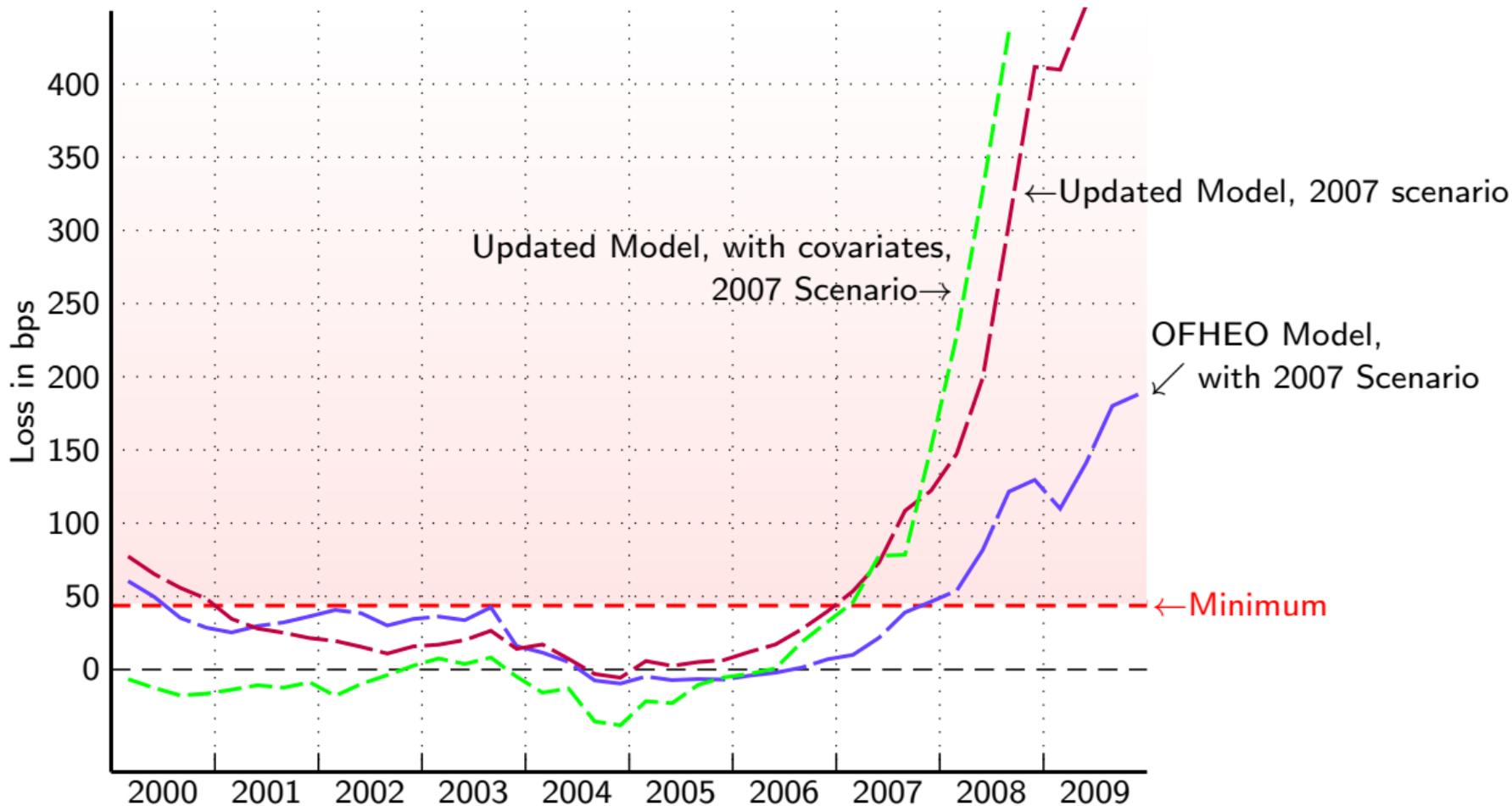
Break down expected losses by loan vintage -- rise in credit risk from 2006 and 2007 vintages. Driven by both the acquisition of riskier loans by Fannie & Freddie and the subsequent decline in home prices.

OFHEOs Stress House Price Path v. The Bust



Risk-Based Capital Calculation

Panel B: 2007 Actual House Price Outcomes



Conclusions

We study a recent U.S. experience with a complex and fully disclosed stress test that failed spectacularly: OFHEO's risk-based capital stress test for Fannie and Freddie.

Focused on a key element of OFHEO's stress test: Models used to predict default and prepayment of 30-year fixed-rate mortgages.

- Poor default forecasts due to lack of model updating (parameters and models).
- Simple improvements would have provided more timely signals about deteriorating GSE mortgage quality and capital needs.

Documented that OFHEO's adverse house price scenario was significantly less stressful than what actually transpired during the recent housing bust.

The failure of OFHEO's stress test may seem one of supervisory failure. But the supervisor faced an important legal constraint pertaining to "replicability" that led to the publication of all models and parameter estimates.

- Current debate about this in the context of bank stress tests.

Stress tests can provide valuable insights, but supervisors should keep in mind their limitations – especially significant model risk.