

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

Paul S. Willen (joint with Kris Gerardi and Scott Frame)

Central Bank of Ireland  
December 4, 2018

These views expressed are those of the authors and do not necessarily reflect those of any entities within the Federal Reserve System.

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## Stress tests

- Since the crisis, many economists and policy makers:
  - Stress tests are a potent weapon to prevent future crises.
  - Had we done stress tests in 2006, we would have appreciated the danger to the financial system and taken action before it was too late.
  - Federal Reserve made stress tests a key part of maintaining financial stability.
- What is a stress test?
  - Propose a bad macroeconomic scenario
  - And ask how a portfolio will perform
- Before the crisis, one government agency did precisely this: OFHEO
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- How did they do?



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## Costs of Bailout

- According to the CBO, the cost of subsidies:

### 1. TARP: \$21 billion<sup>1</sup>

AIG	\$15
Mortgage Programs (HAMP, etc.)	\$16
Auto Industry	\$17
Capital Purchase Program	−\$17
Additional Assistance to Citi and BofA	−\$8
Other	−\$2
<b>Total</b>	<b>\$21</b>

### 2. Fannie and Freddie (2009 only): \$291 billion<sup>2</sup>

<sup>1</sup>See Table 1 in “Report On The Troubled Asset Relief Program,” May 2013.

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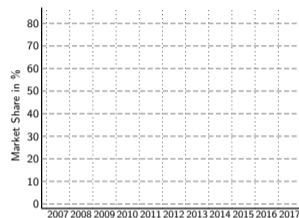
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# Fannie and Freddie Today

## Originations

- Account for
- 60 percent of new originations
  - 60 percent of purchase
  - 60 percent of refis
- 60 percent of outstanding mortgage debt
- Taken over by the government in Sept 2008
  - Still in “conservatorship”
- Increasing low down payment loans.
- Customer and competitor to major banks



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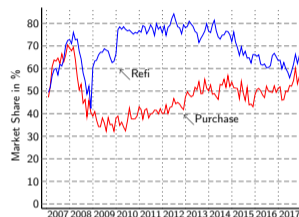
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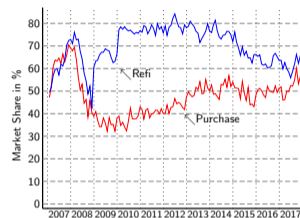
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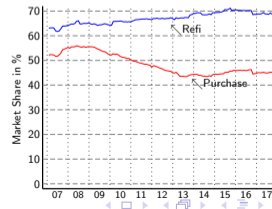
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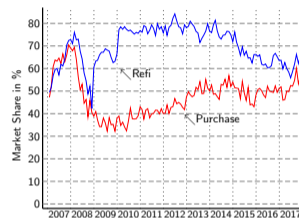




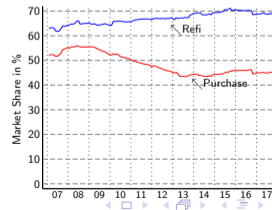
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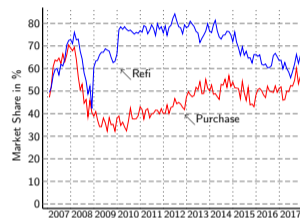
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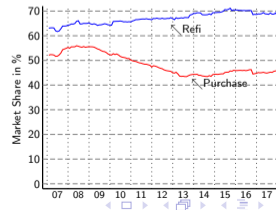
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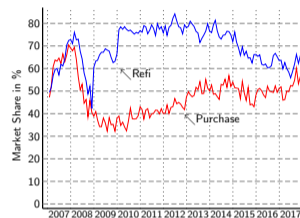
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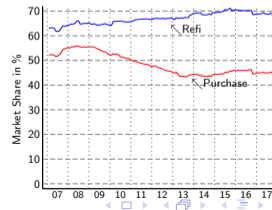
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  1. Owned a large portfolio of risky assets
    - Mortgages
    - Mortgage-backed securities they issued
    - Private Label MBS
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  2. Guaranteed the timely payment of interest and principal to investors in the MBS they issued
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# The OFHEO Capital Requirement

- Federal Housing Enterprise Financial Safety and Soundness Act of 1992 (the 1992 Act)
  - Established two different minimal levels of capital for the agencies
1. “Minimum Capital Requirement”:
    - 2.5% of portfolio assets
    - 0.45% of mortgages that they guaranteed.
  - In 2006, Fannie Mae guaranteed about \$2.7 trillion of mortgages
    - Must hold \$12 billion.
    - If 1% of Fannie mortgages defaulted and Fannie could recover two-thirds of the money through foreclosure, would lose \$9 billion
  2. “Risk-Based Capital” (RBC) requirement
    - Each firm must “maintain positive capital throughout a 10-year period of stressful credit and interest rate conditions.”

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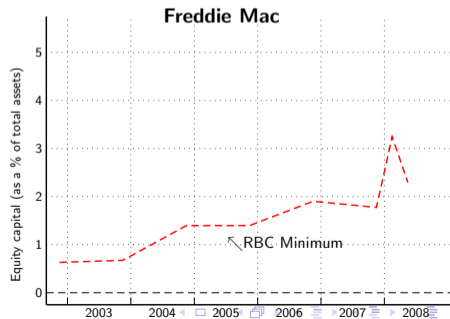
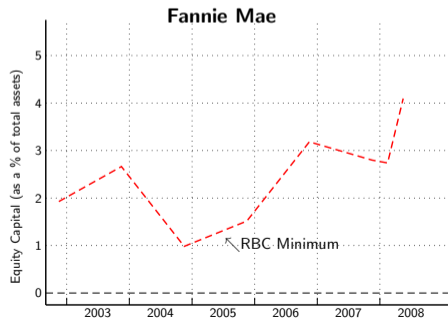
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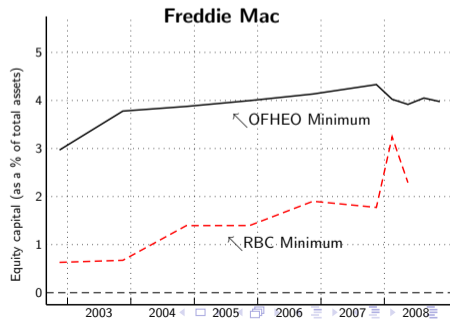
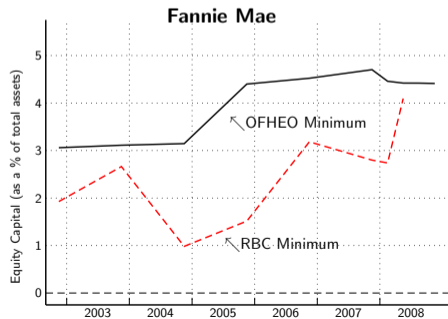
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- OFHEO RBC Stress Tests done for 23 quarters.
- RBC was never binding
- I.e. “Minimum Capital Requirement” > RBC
- Reported capital always exceeded requirements
- Until it didn't.



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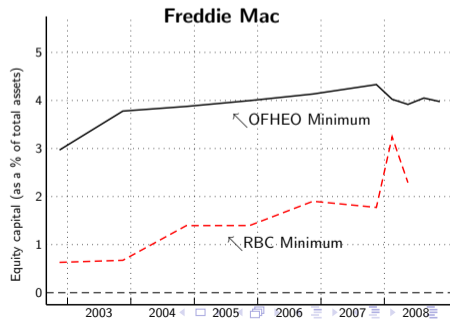
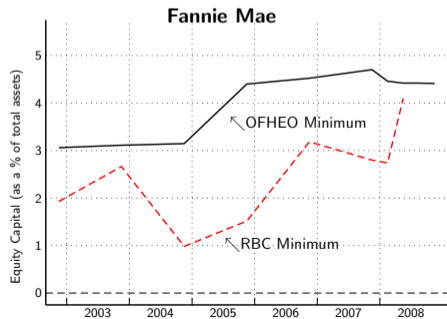
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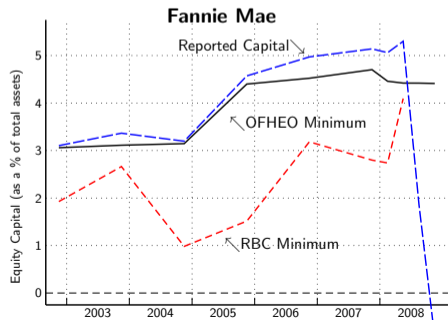
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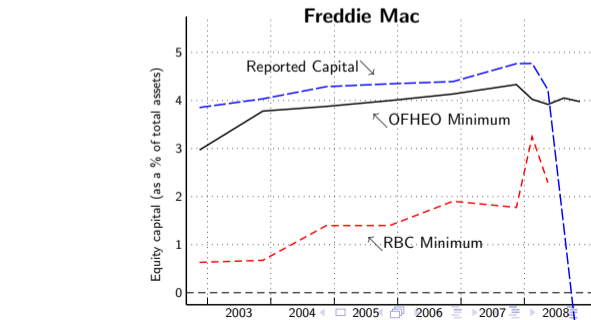


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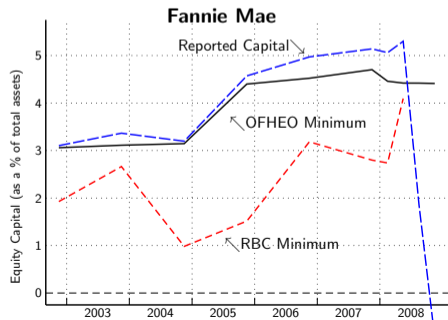


Proposed Rule

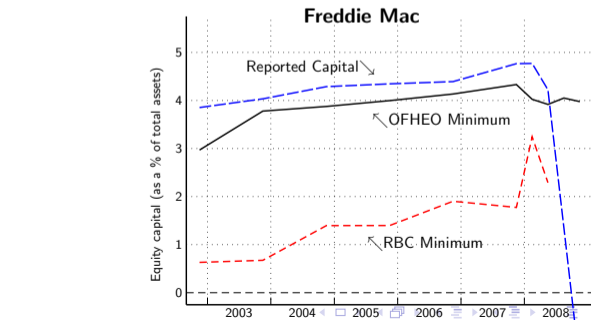
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December 4, 2018

## Simple Model of Mortgage Capital

- Capital( $t$ ) is capital,  $UPB$  is unpaid principal balance,  $\lambda_d(t)$  is the default hazard,  $\lambda_p(t)$  is the prepayment hazard,  $r(t)$  is the interest rate.

$$\text{Cap.}(T) = \text{Cap.}(0) \exp^{\int_0^T r(t)dt} + \underbrace{\int_0^T \exp^{\int_t^T r(t)dt} \text{UPB}(t) \left( \text{gfee}(t) - \lambda_d(t) \text{LGD}(t) \right) dt}_{\text{Net Additions to Capital}}$$

- Capital( $T$ )  $\geq 0$  implies that

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- To have positive capital at time  $T$ , must hold the present discounted value of all losses less all income from guarantee fees.

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## Computing capital

- Assume:  $UPB(t) = UPB(0) \exp(-\int_0^t (\lambda_p(s) + \lambda_d(s)) ds)$

$$\frac{\text{Capital}(0)}{UPB(0)} \geq \int_0^T \exp^{-\int_0^t (r(s) + \lambda_p(s) + \lambda_d(s)) ds} (\lambda_d(t) \text{LGD}(t) - \text{gfee}(t)) dt \quad (2)$$

- Must forecast  $\lambda_p(t)$ ,  $\lambda_d(t)$ ,  $\text{LGD}(t)$ .
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  - Scenario: path  $P(t)$ ,  $r(t)$
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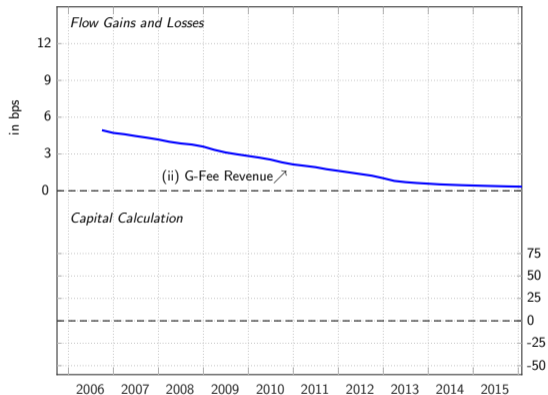
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- Actual evolution for 2005Q4 book of business
  - How much capital did Fannie and Freddie need *ex post*
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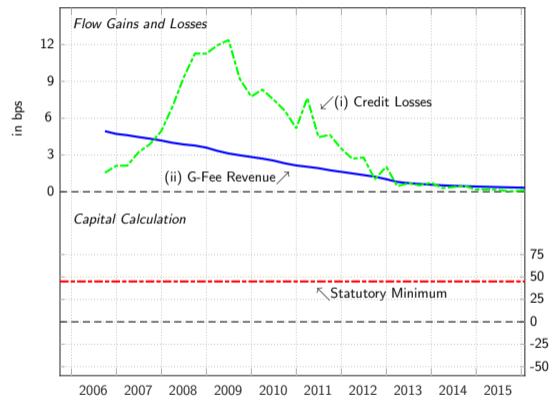
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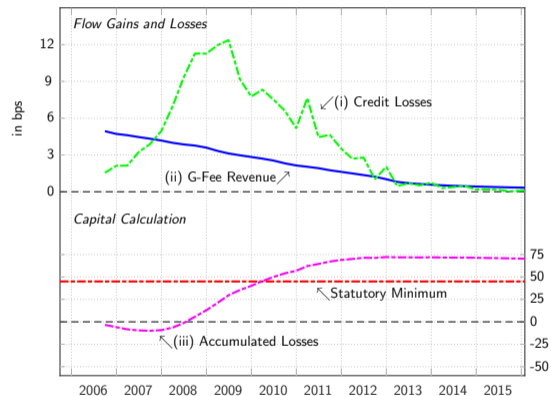
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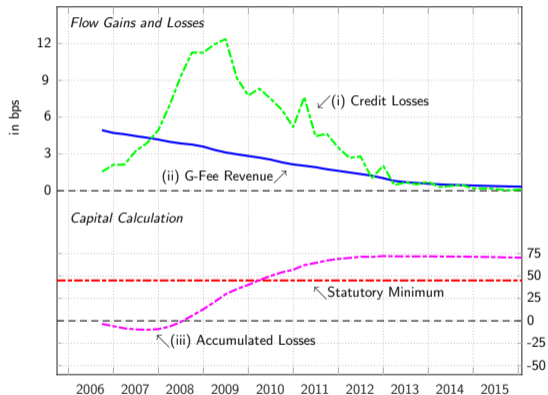
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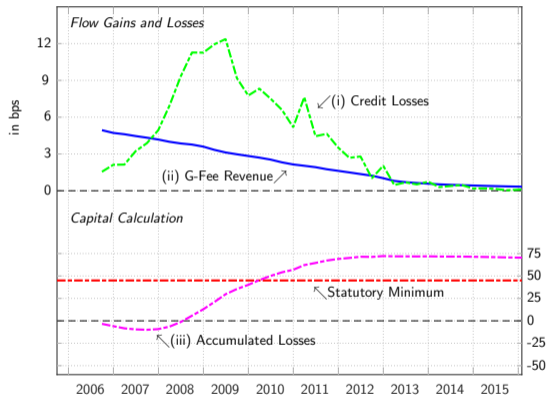
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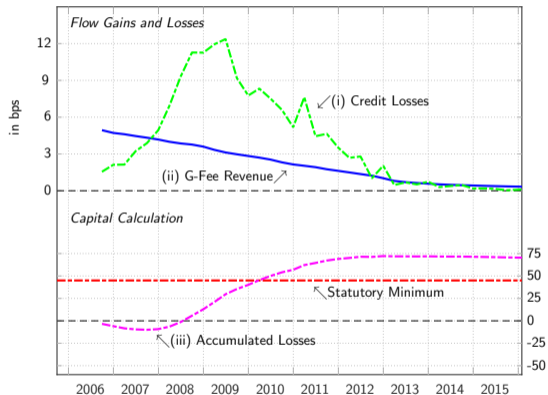
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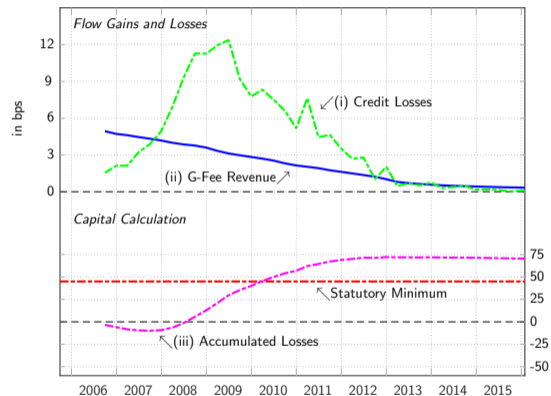
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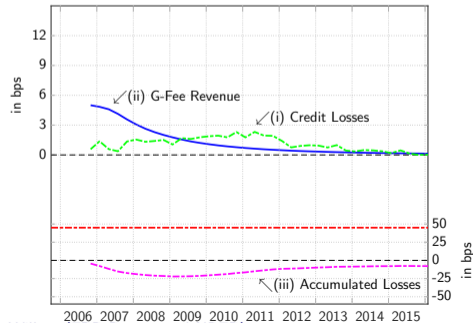
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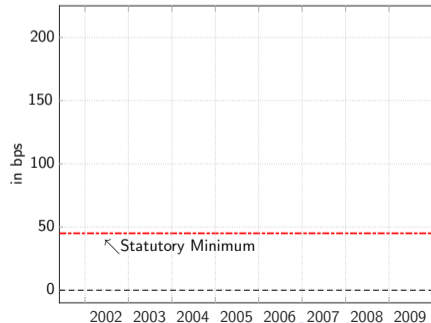
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Q4,2006



Willen (FRB Boston and NBER)

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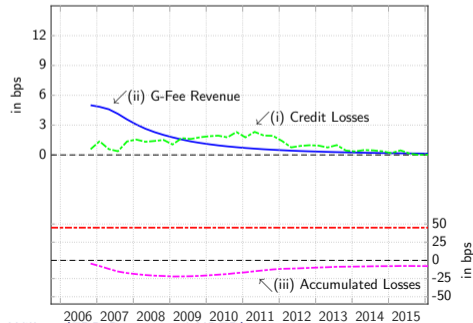


Proposed Rule  
December 4, 2018

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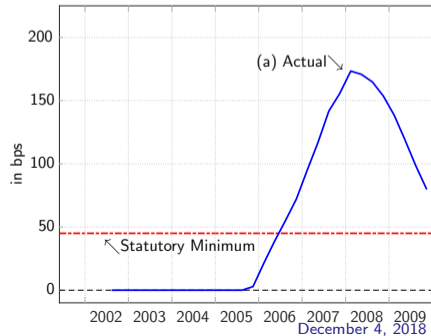
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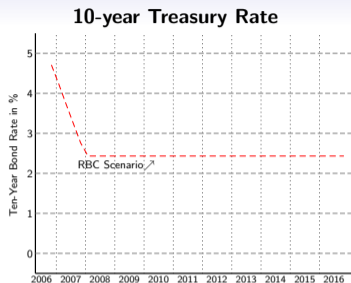


December 4, 2018

Proposed Rule

# Implementation

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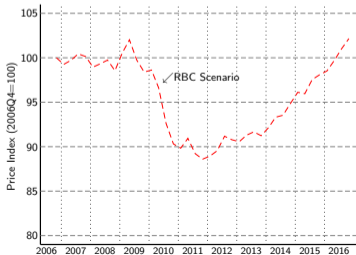
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## 10-year Treasury Rate



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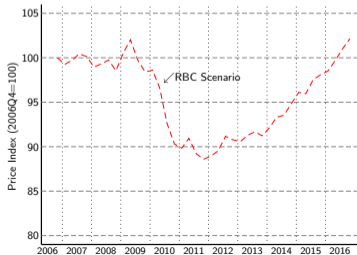


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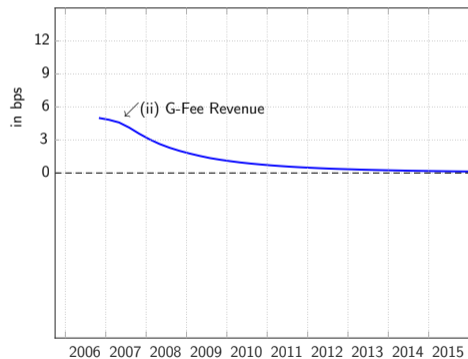
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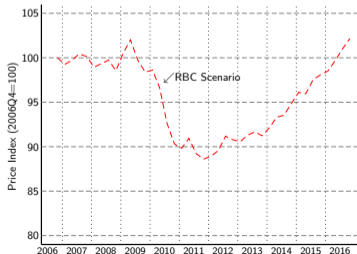


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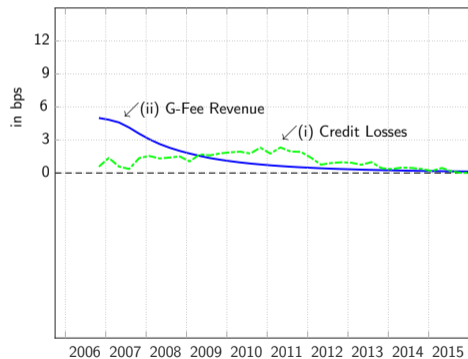
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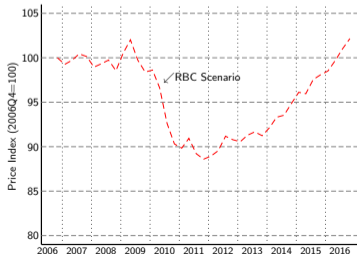


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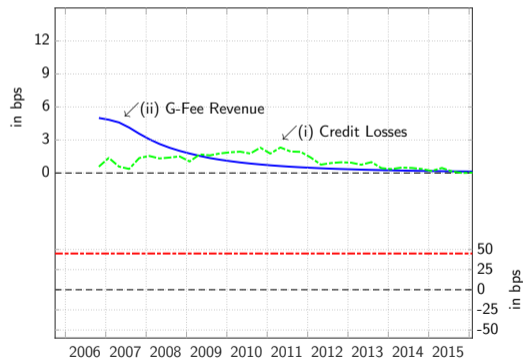
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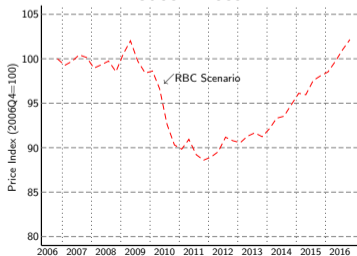


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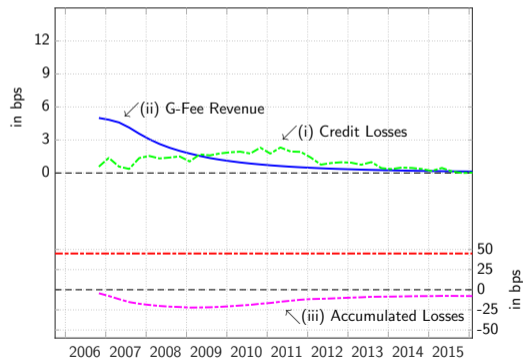
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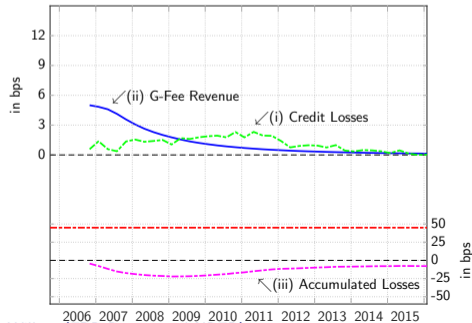
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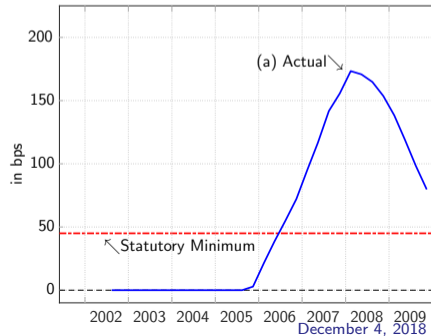
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Willen (FRB Boston and NBER)

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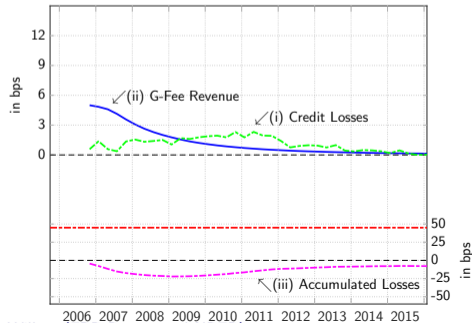


Proposed Rule

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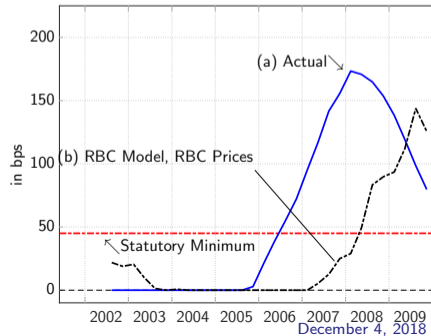
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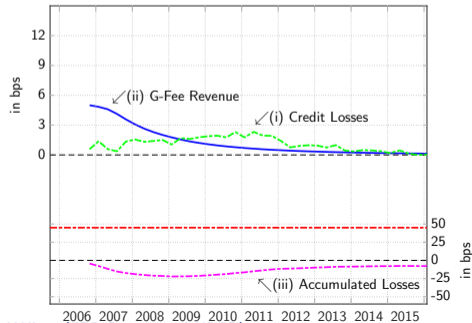


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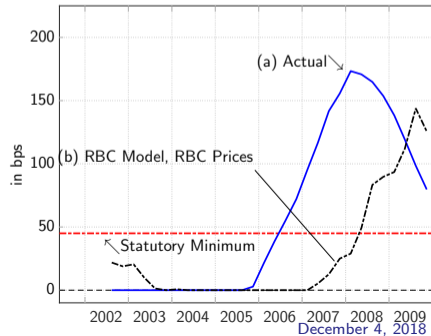
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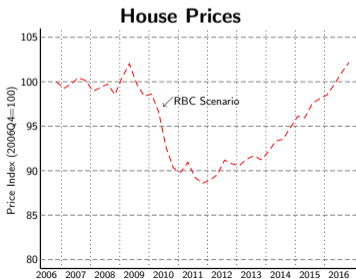


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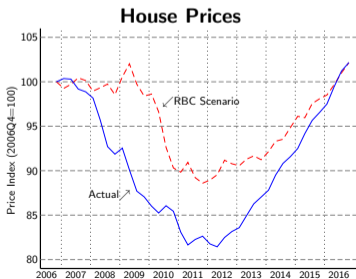
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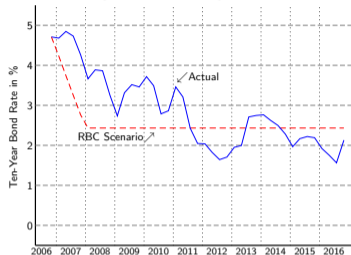
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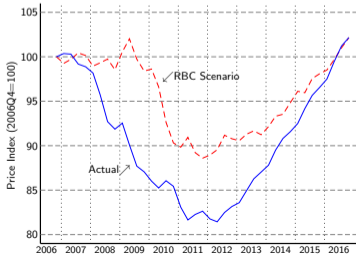
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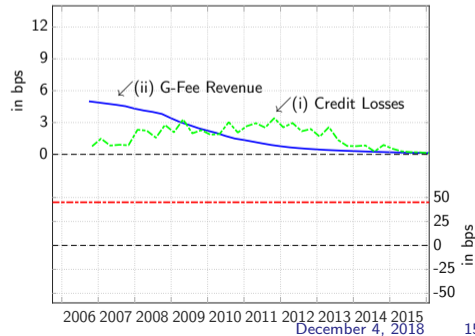
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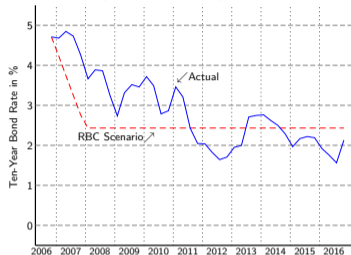
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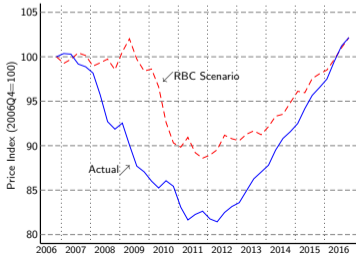
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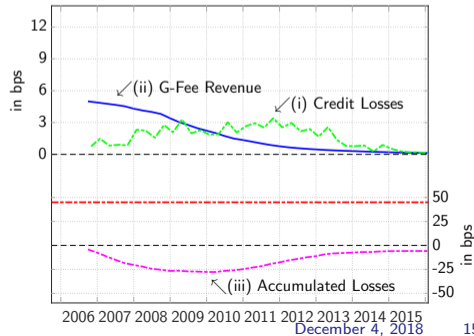
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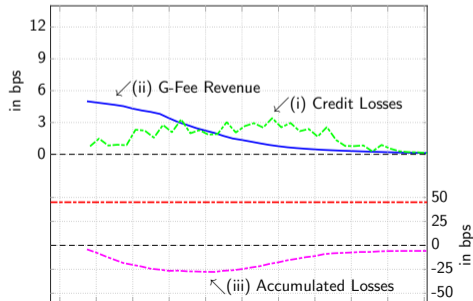
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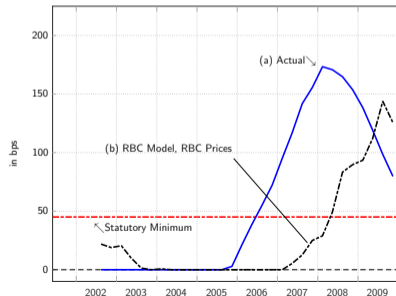
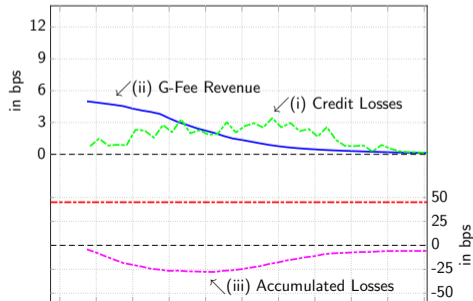
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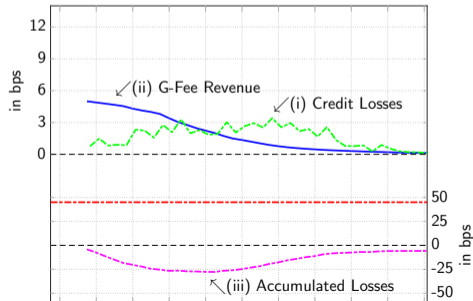
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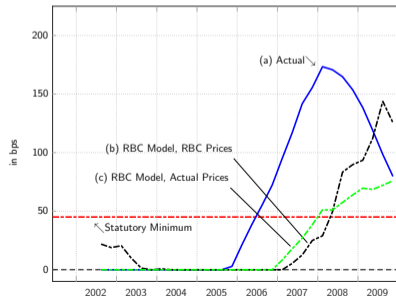
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Willen (FRB Boston and NBER)



Proposed Rule

December 4, 2018



## A simple approximation

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- Assume everything is constant over time and  $T = \infty$ :

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- The numerator

$\overline{\lambda_d}$	10bps	8bps	15bps
$\times \overline{\text{loss}}$	50%	30%	50%
$-\overline{\text{gfee}}$	5bps	5bps	5bps
=	0bps	-2.6bps	+2.5bps

- Multiplier ( $1/(\bar{r} + \overline{\lambda_p} + \overline{\lambda_d})$ )

$r$	1% <sub>s</sub>	1%
$\lambda_d$	20bps	
$\lambda_p$	5%	10%
$\approx$	16	9

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- Multiplier ( $1/(\bar{r} + \overline{\lambda_p} + \overline{\lambda_d})$ )

$r$	1% <sub>s</sub>	1%
$\lambda_d$	20bps	
$\lambda_p$	5%	10%
$\approx$	16	9

## A simple approximation

- Capital equation:

$$\frac{\text{Capital}(0)}{\text{UPB}(0)} \geq \int_0^T \exp^{-\int_0^t (r(s) + \lambda_p(s) + \lambda_d(s)) ds} (\lambda_d(t) \text{LGD}(t) - \text{gfee}(t)) dt \quad (3)$$

- Assume everything is constant over time and  $T = \infty$ :

$$\frac{\text{Capital}(0)}{\text{UPB}(0)} = \frac{\overline{\lambda_d} \cdot \overline{\text{loss}} - \overline{\text{gfee}}}{\bar{r} + \overline{\lambda_p} + \overline{\lambda_d}} \quad (4)$$

- The numerator

$\overline{\lambda_d}$	10bps	8bps	15bps
$\times \overline{\text{loss}}$	50%	30%	50%
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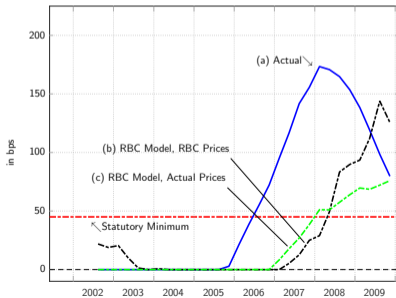
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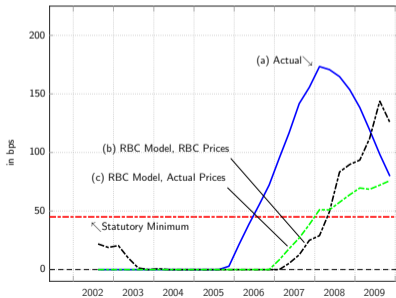
### RBC Capital



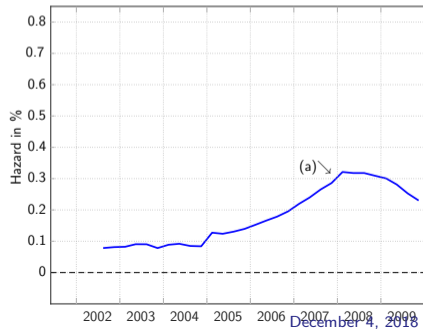
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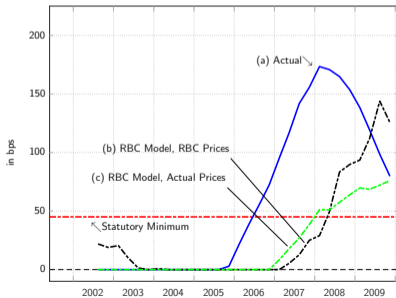
### 10-yr weighted average default



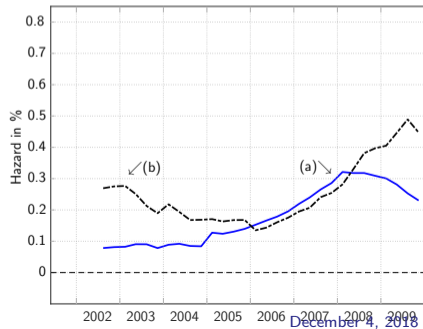
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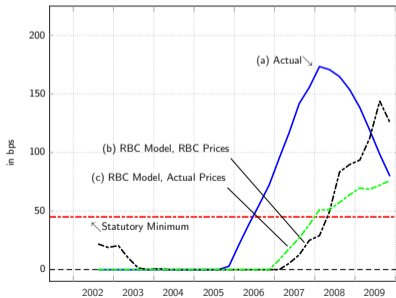
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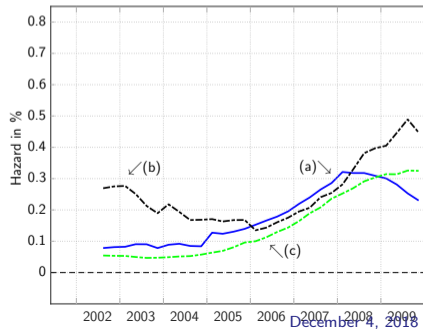
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### RBC Capital



### 10-yr weighted average default

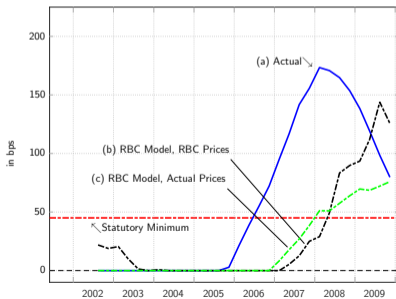




# Prepayment

$$\frac{\text{Capital}(0)}{\text{UPB}(0)} = \frac{\overline{\lambda_d} \cdot \overline{\text{loss}} - \overline{\text{gfee}}}{\overline{r} + \overline{\lambda_p} + \overline{\lambda_d}}$$

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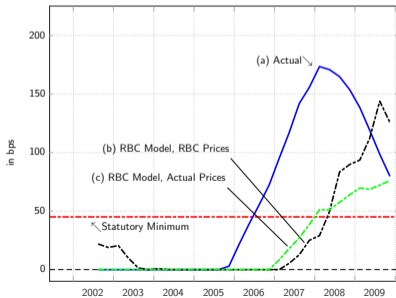


## 10-yr weighted average prepayment

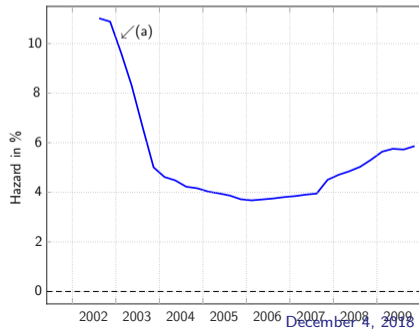
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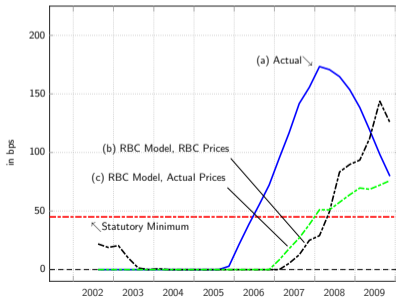
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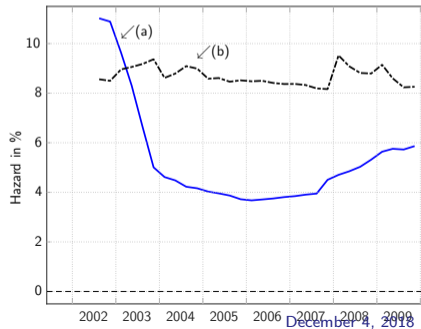
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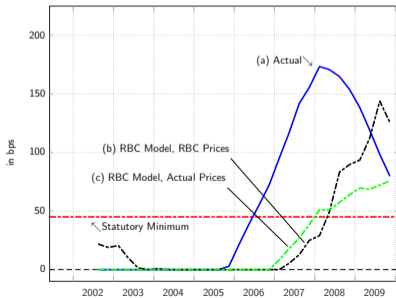
## 10-yr weighted average prepayment



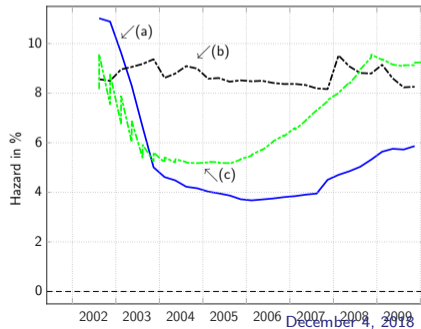
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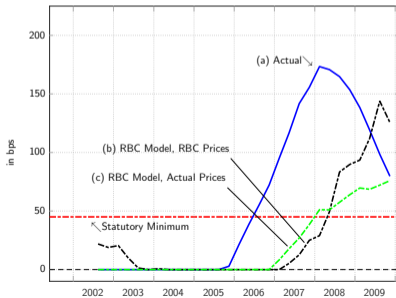
## 10-yr weighted average prepayment



## Loss Given Default

$$\frac{\text{Capital}(0)}{\text{UPB}(0)} = \frac{\overline{\lambda_d} \cdot \overline{\text{loss}} - \overline{\text{gfee}}}{\overline{r} + \overline{\lambda_p} + \overline{\lambda_d}}$$

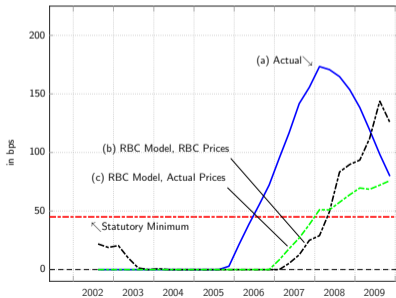
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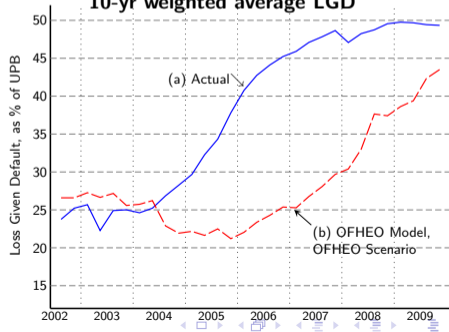
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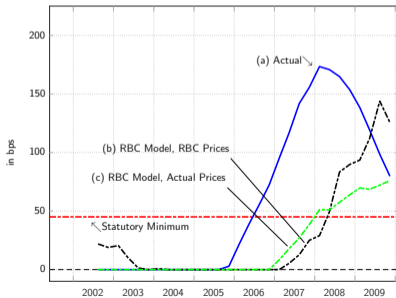
### 10-yr weighted average LGD



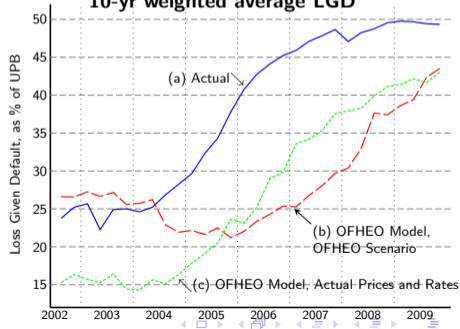
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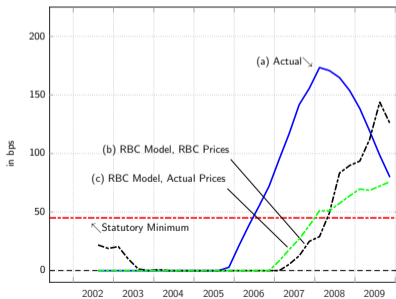
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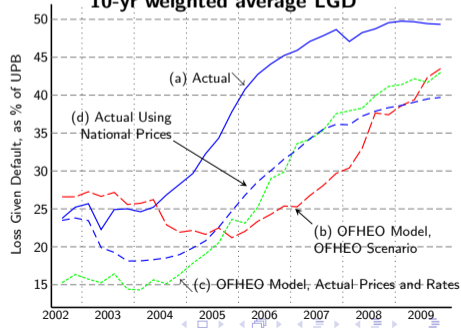
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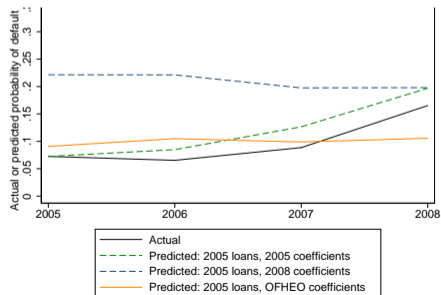




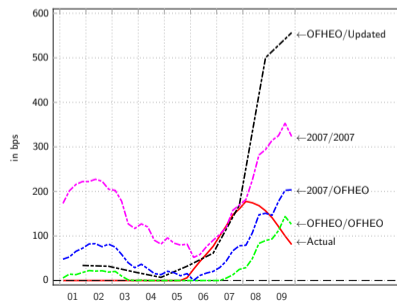
## Alternatives: Updating

- OFHEO model was “frozen” in 1999.
- Never Updated.

### Different Parameters



### RBC Capital using Updated coefficients



## Alternative: Ex post capital

- Minimum capital inequality:

$$\frac{\text{Capital}(0)}{\text{UPB}(0)} \geq \int_0^T \exp^{-\int_0^t (r(s) + \lambda_p(s) + \lambda_d(s)) ds} (\lambda_d(t) \text{LGD}(t) - \text{gfee}(t)) dt \quad (5)$$

- Example replicate for crisis:  $\lambda_p(t)$ 
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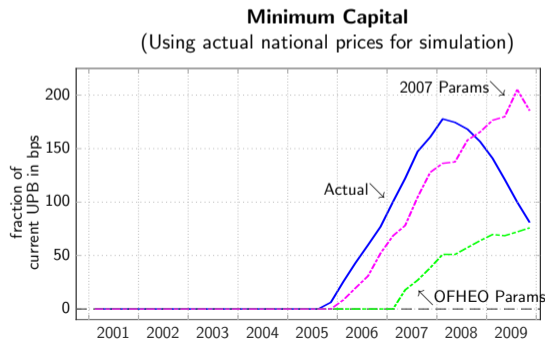
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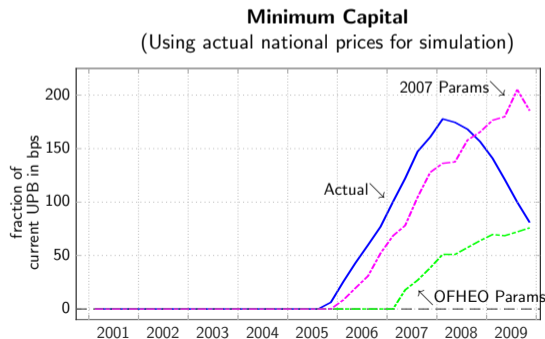
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# The slide you've all been waiting for...

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