November 16, 2018

Analysis of FHFA Proposal on Enterprise Capital

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1. Introduction

Capital standards for single family residential mortgages are important! Too much capital raises mortgage rates and reduces homeownership; too little capital result in insolvency and financial crises. The Federal Housing Finance Agency (FHFA) recently (https://www.fhfa.gov/Media/PublicAffairs/Pages/FHFA-Issues-Proposed-Rule-on-Enterprise-Capital.aspx) issued a proposed capital standard for the government sponsored enterprises (GSEs), Freddie Mac and Fannie Mae. This capital standard was intended to both provide a framework to think about business decisions while the GSE remain in conservatorship, as well as to communicate the FHFA's view of capital as the GSE reform discussion continues.

In this brief, we analyze two questions:

1. How well does the rule align risk and capital across the various mortgage attributes?
2. How does the capital requirement vary across the business cycle?

By addressing these two questions, we can begin to understand whether the capital standards are appropriately calibrated.

Even though the GSEs are in conservatorship, these capital standards are far more than an academic exercise, the expectation is that they will be used to govern pricing for the duration of the GSEs conservatorship. And, given the deep divisions in Congress that could be a very long time.

To answer the first question, we compute the capital requirements for a large variety of mortgages; to answer the second, we compute the capital requirements at various times over the business cycle. As the rule is complex, this requires a good deal of computation and the making of various assumptions.

Our principal observations are:

1. In general, FHFA has captured the most important risk attributes and directionally has aligned capital with the risk.
2. For a variety of higher risk mortgages, especially those products used by first-time home buyers and for many Low and Moderate Income (LMI) households, the proposal over-penalizes risk, i.e., allocates more capital than the data would support.
3. The standard is quite pro-cyclical, with capital standards either doubling or halving in a two-year period.

The remainder of the paper is organized as follows: Section 2 (Methodology) briefly describes our computations. Section 3 (Capital by Mortgage Attribute) presents our loan level findings, largely in a series of tables. Section 4 (Capital and the Business Cycle) puts this capital standard into a broader framework. In Section 5 (Discussion), we discuss what features of the proposal drive the above results and address alternative formulations that may improve the proposal. Note that we are confining our

discussion to the single family part of the GSE business, we are not addressing the multifamily discussion at all.

2. Methodology

The FHFA proposal is quite detailed with the capital requirement on a 1-4 family mortgage depending a list of mortgage attributes at origination (See Table 1), updated attributes for current LTV and FICO, the age of the mortgage, and the history of delinquency status over the last 3 years. For the empirical work in this study, we used the Fannie Mae loan level credit data that is published as part of its credit risk transfer bond programs. This database contains information on fixed rate, fully amortizing mortgages; it does not include adjustable rate mortgages or mortgages with non-traditional features (interest only, negative amortization, 40-year mortgages). For our analysis, we used 30-year mortgages only (terms of 241 and greater). The database includes loan age, loan purpose, loan type, property type, loan amount, performance history, original FICO score, original LTV, original debt-to-income ratio (DTI), and geographic information at the 3-digit zip code level.

Table 1: Mortgage Attributes

Attribute	Description
Loan age	Loan age at the time of measurement
Pay performance	36 months of pay history
FICO	refreshed FICO
MTMLTV	Mark-to-Market LTV
Property type	Risk multiplier, 1 Unit 1.0; 2-4 Units 1.4; Condo 1.1, Manufactured home 1.3.
Loan Purpose	Risk multiplier, purchase loans 1.0; cash-out refinance is 1.4 and rate refinance is 1.3.
Occupancy Type	Risk multiplier, Owner-occupied or second home 1.0; Investment 1.2
Number of borrowers	Risk multiplier, one borrower 1.5; multiple borrowers 1.0
DTI ratio	Risk multiplier, DTI<=25% 0.8; 25-40% 1.0; >40% 1.2
Loan size	Risk multiplier, UPB<=50K 2.0; $50K-100K 1.4; UPB>100K 1.0

The proposal uses loan age and pay history to partition the single-family universe into five loan segments. We partitioned in the same manner. The five segments are:

(1) New originations: Loans that were originated within 5 months of the capital calculation date and have never been 30-days delinquent.
(2) Performing seasoned: Loans that were originated at least 5 months before the capital calculation date and have been neither 30-days delinquent nor modified within 36 months of the capital calculation date with some additional delinquency history requirement.
(3) Non-modified re-performing: Loans that are currently performing and have had a prior 30-day delinquency, but not a prior modification.
(4) Modified re-performing: Loans that are currently performing and have had a prior 30-day delinquency and a prior modification.
(5) Non-performing: Loans that are currently at least 30-days delinquent.

For each segment, the proposal uses two-dimensional grid: Mark to market LTV (MTMLTV) and refreshed credit score. For this study, we do not have the updated FICO scores so we use FICO at origination for all our calculations. As a result, we are likely to overestimate the capital standard in good times as FICOs tend to improve with the economy and underestimates the capital standard in bad times. On average, this is a conservative assumption because the capital requirements go up more in bad times than they come down in good times. The state level CoreLogic Home Price Index is used to calculate the MTMLTVs.

After we calculate the base credit risk requirement for each loan, we adjust this number to account for additional characteristics, defined as risk multipliers in the proposal. The proposal and our adjustments include risk multipliers such as loan purpose, occupancy type, property type, number of borrowers, Debt-To-Income (DTI) ratio, loan size and loan age.

In the proposal, the risk multipliers are applied to adjust the base credit risk capital. Mortgages over 95 LTV are capped at a risk multiplier of 3. We follow suit in our calculations.

Finally, need to take into account the credit enhancement through MI. We use the origination LTV and loan age to determine the credit enhancement, assuming cancellable mortgage insurance(MI) with guidance level coverage. Based on the proposal, we also consider the counterparty credit risk as well. To account for this exposure, the credit enhancement would be reduced to incorporate the risk that counterparties are unable to meet the claim obligations. We assumed the counterparty rating of "3" with high mortgage concentration risk. Under this assumption, for non-performing loans, we use 3.9 percent haircut; for other loans, the number is 8.3 percent.

With all the information at hand, we compute the net credit capital requirement for each mortgage in the data set at the end of each exposure year from 2002 to 2016. As discussed above, the capital standard applies a different model depending on whether the mortgage is a newly originated mortgage, a performing seasoned mortgage, a delinquent mortgage, or re-performing mortgage. At any point in time the percentage in each bucket will vary. Therefore, we analyze the GSE portfolio at various times over the business cycle. It would be a mistake to just look at the capital standard of newly originated mortgages to draw conclusions about the proposal as these tend to represent well under 10 percent of the GSEs portfolio.

Note that we focus primarily on the credit risk component of the proposed capital standard. As FHFA reports (based on calculations for Sept 2017), this is the largest single risk ($112 billion before credit risk transfers, $90.5 billion after), and, even after credit risk transfers, accounts for about half of the capital ($180.9 billion) required of the GSEs as of September 30, 2017. However, the proposal also includes a going concern buffer ($39.9 billion), an operational risk charge ($4.3 billion), and market risk component ($19.4 billion). See the table from the proposal, reproduced below, for more details.

TABLE 5—FANNIE MAE AND FREDDIE MAC ESTIMATED RISK-BASED CAPITAL REQUIREMENTS AS OF SEPTEMBER 30, 2017—BY RISK CATEGORY

	Fannie Mae capital requirement			Freddie Mac capital requirement			Enterprises' combined capital requirement		
	$billions	bps	Share (%)	$billions	bps	Share (%)	$billions	bps	Share (%)
Net Credit Risk	$70.5			$41.5			$112.0		
Credit Risk Transferred	(11.5)			(10.0)			(21.5)		
Post-CRT Net Credit Risk	59.0	176	51	31.5	142	48	90.5	162	50
Market Risk	9.5	28	8	9.9	44	15	19.4	35	11
Going-Concern Buffer	24.0	72	21	15.9	71	24	39.9	72	22
Operational Risk	2.6	8	2	1.7	8	3	4.3	8	2
Other (DTA)***	19.9	59	17	6.8	31	10	26.8	48	15
Total Capital Requirement	115.0	343	100	65.9	296	100	180.9	324	100
Total Assets and Off-Balance Sheet Guarantees, $billions	3,353.1			2,226.0			5,579.0		

*The DTA capital requirement is a function of Core Capital. Both Enterprises have negative Core Capital as of September 30, 2017. In order to calculate the DTA capital requirement, we assume Core Capital is equal to the Risk-Based Capital Requirement without consideration of the DTA capital requirement.
**Both Enterprises' DTAs were reduced in December 2017 as a result of the change in the corporate tax rate. The risk-based capital requirement for DTAs as of December 31, 2017 would be $10.0 billion or 30 bps for Fannie Mae and $1.2 billion or 5 bps for Freddie Mac. See Table 33 and Table 34 for more detail.

Section 3: Capital by Mortgage Attribute

3a: LTV & FICO

The two primary risk attributes for a 30-year fixed rate mortgage are the loan-to-value (LTV) at origination and the FICO score at origination. The FHFA capital requirements vary significantly by these two attributes. Using the methodology outlined above, we computed the capital requirement in Table 2 by FICO and LTV for GSE purchase money mortgages as of December 31, 2016.

Table 2: Capital Requirement as of Year-end 2016

FICO/LTV	<=30%	<30-60%	<60-70%	<70-75%	<75-80%	80<-85%	85<-90%	90<-95%	95<-97%	All
<620	399	418	647	807	832	904	1006	1132	1176	898
620 - <640	153	217	366	513	621	750	754	755	907	632
640 - <660	136	168	291	426	515	654	613	606	707	525
660 - <680	89	132	229	313	415	540	500	470	594	424
680 - <700	66	100	170	253	343	433	398	389	503	356
700 - <720	55	76	140	194	260	337	309	304	427	277
720 - <740	32	64	109	154	209	274	246	250	351	227
740 - <760	35	49	87	120	163	215	195	197	277	177
760 - <780	23	37	62	91	124	160	148	153	217	132
>=780	17	25	44	63	87	114	105	109	156	87
All	33	49	93	126	173	231	210	225	321	186

In order to determine if these capital charges are appropriate, we need to compare the capital requirement to the stressed losses. We believe it is very important to compare the capital charges to the stressed losses, not the losses over the course of the cycle, as the purpose of these capital requirements is to make sure the institution has enough capital to withstand a crisis. It may be the case that some of

the loans that have a lower probability of default in good times actually perform comparatively worse in bade times. We used the 2007 originations, a very stressed year, to run this comparison.

More precisely, we restricted the database to purchase loans originated in 2007; and tracked their performance through the end of 2016; we tabulated losses as of that point. We sorted these loans into FICO/ LTV buckets and calculated the loss rate for each bucket. For the liquidated loans, we have actual losses. For the active loans, we calculate the D180 rates (delinquent for 180 days or more). We then assume 65 percent liquidation given D180, and 50 percent loss severity given liquidation. Table 3 shows the loss rate for 2007 loans by FICO and LTV categories. To compare to the numbers in Table 2, we re-weighted these buckets to reflect the current business mix (as 2007 had a larger percentage of lower FICO borrowers). Our results show we would have needed 170 basis points (bps) capital if each loan on the books today went through the 2007 experience; this is very similar to the 186 bps of required capital that we calculated in Table 2. Thus, on average these capital requirements are high enough for the GSEs to have survived the Great Recession.

Table 3: Loss Rate Calculation for 2007 originations

FICO/LTV	<=30%	<30-60%	<60-70%	<70-75%	<75-80%	80<-85%	85<-90%	90<-95%	95<-97%	All
<620	95	242	602	558	604	527	518	594	1223	575
620 - <640	4	135	210	395	547	657	480	523	464	479
640 - <660	67	39	170	305	405	463	341	460	489	377
660 - <680	58	43	178	236	328	334	350	419	597	327
680 - <700	0	26	113	187	274	282	270	345	442	261
700 - <720	0	12	85	213	223	234	249	337	434	218
720 - <740	0	19	64	133	166	142	208	236	276	159
740 - <760	0	13	40	96	131	115	185	215	347	130
760 - <780	0	2	26	58	98	130	159	159	295	92
>=780	0	5	15	43	71	66	97	120	130	57
All	4	17	65	122	171	215	237	301	448	170

While we have shown the aggregate required capital is correct, does this proposal correctly allocate capital across FICO and LTV buckets? To analyze this, we compare the slope of the required capital to the slope of the actual losses for different FICO and LTV categories. We first compare the capital requirements on loans with a 640-660 FICO to that of loans with 740-760 FICOs at two different LTV levels: 75-80 LTV (lower LTV) and 90-95 LTV (higher LTV). For loans in the (75-80 LTV, 640-660 FICO) bucket, Table 2 shows that the capital requirement is 515, it is 163 for loans in the (75-80 LTV, 740-760 FICO) bucket, resulting a slope of 515/163=3.16. Roughly speaking, 660 FICO mortgage needs approximately 3 times the capital of a mortgage with the same LTV but a 760 FICO. Now we calculate the slopes for the loss rate. Table 3 shows the losses for (75-80 LTV, 640-660 FICO) mortgages were approximately 405/131=3.08 times that of the (75-80 LTV, 740-760 FICO) mortgages. Thus, the FICO slope for capital is in line with the FICO slope for loss for the low LTV loans. This is summarized in the top line of Table 4.

However, as shown in the second line of Table 4, for high LTV loans (e.g. 90-95 LTV), there is a disparity in the two slopes. The losses for low FICO (e.g. 640-660 FICO) were about 2 times that of high FICO (e.g.

740-760 FICO) mortgage. At the same time, the capital slope is 3 times. Thus, it would seem that the proposal overcapitalizes lower FICO higher LTV loans.

Consider another example in which we look across the LTV dimension. A 700-720 FICO, 95 LTV mortgage needs approximately 1.57 times the capital of a mortgage with the same FICO but a 70 LTV (304/194). This is very close to the n the 1.51 that actual losses would suggest.

Our conclusion: the lower FICO higher LTV mortgages require more capital than in necessary relative to their less risky brethren. These results stem from the fact that in a stress scenario, all mortgages perform much worse, but the relative differential between mortgages with weaker credit and those with stronger credit is less than during normal periods. Since the model is attempting to model a stress scenario, this should be taken into account in the next revision of this framework.

Table 4: Slope Calculation

Slope	Description	Capital	Loss
FICO slope with low LTV	75-80 LTV; 640--660 FICO/ 740-760 FICO	515/163=3.16	405/131=3.08
FICO slope with high LTV	90-95 LTV, 640--660 FICO/ 740-760 FICO	606/196=3.08	460/215=2.14
LTV slope	700-720 FICO; 90-95 LTV/75-80 LTV	304/194=1.57	337/223=1.51

3b: Layered risk

While LTV and FICO are the principal risk factors, there are an assortment of other factors that when combined or "layered" into one mortgage can significantly increase risk. These risk factors include single borrower, manufactured housing, rate/term refi, high debt to income (DTI) ratios, and small loan size. all these factors into one mortgage. FHFA has incorporated these through a series of risk multipliers. The analysis in the previous section included these multipliers. In this section, we will drill down more deeply in these multipliers. Table 5 shows the average risk multipliers by FICO and LTV bucket. While the average risk multiplier in the sample is about 1.18, low FICO and high FICO loans have higher risk multipliers.

Table 5: Risk Multipliers

FICO/LTV	<=30%	<30-60%	<60-70%	<70-75%	<75-80%	80<-85%	85<-90%	90<-95%	95<-97%	All
<620	2.15	1.84	1.74	1.79	1.66	1.64	1.65	1.74	1.93	1.72
620 - <640	1.75	1.51	1.48	1.46	1.44	1.44	1.45	1.46	1.87	1.47
640 - <660	1.56	1.41	1.40	1.40	1.36	1.39	1.37	1.38	1.79	1.39
660 - <680	1.44	1.31	1.33	1.31	1.29	1.35	1.32	1.32	1.79	1.33
680 - <700	1.46	1.27	1.27	1.27	1.26	1.30	1.29	1.31	1.78	1.32
700 - <720	1.38	1.20	1.20	1.20	1.19	1.22	1.22	1.25	1.80	1.26
720 - <740	1.28	1.17	1.16	1.16	1.15	1.19	1.19	1.23	1.74	1.23
740 - <760	1.27	1.14	1.14	1.13	1.12	1.16	1.16	1.20	1.70	1.19
760 - <780	1.20	1.09	1.09	1.09	1.09	1.12	1.12	1.17	1.69	1.15
>=780	1.19	1.08	1.07	1.07	1.06	1.08	1.09	1.14	1.64	1.10
All	1.25	1.13	1.13	1.13	1.12	1.16	1.16	1.21	1.72	1.18

Under the CCF, the FHFA has chosen to cap risk multipliers at 3 for loans with LTV above 95 to encourage this "affordable" lending. However, the bulk of the lending (anything below 95 LTV) is uncapped. In Table 6, we give an example when capital level can be very high. In this example, the multiplier is 6.1. So, the gross capital requirement would increase from a base of 240 bps to 1464 bps.

Table 6: An example for the risk factors

FICO 720, LTV 80, base capital	240 bps
	Risk multipliers
If single borrower	1.5
If manufactured housing	1.3
Rate Refi	1.3
41 DTI	1.2
$50,000 Loan size	2
Total multiplier	6.1
Gross capital	1464 bps

To actually compare the capital requirement and actual loss, we extract a sample of loans as of December 31, 2016 with the following conditions: Rate refi, >=41 DTI, <=$50,000 Loan size, and single borrower. Table 7 shows the calculation on these 1811 loans. The average base capital is 128 bps. The average risk multiplier in this case is 3.5, resulting in a gross capital of 385. The actual loss is 239 (using the methodology outlined above for the loans still on the books). Thus, the risk multiplier that the CCF applies to the base capital requirement is higher than the actual losses would suggest. There is no question that loans with layered risk are more risky, the question is whether a multiplicative approach using these risk factors is produces capital requirements consistent with this risk. We have not done an exhaustive review of the consequences of this risk layering, but urge the FHFA to do so.

There are also public policy implications of these capital charges. Many of these risk multipliers are loans to populations that will otherwise be driven to FHA, where there is no risk based pricing at all. If the goal is to protect the taxpayers, it is not clear that is being accomplished by over-penalizing these borrowers.

One final point. Some of these risk factors such as single borrower are more prevalent in certain populations (unmarried black women, for example). As a result, improper calibration of these factors may raise fair lending issues.

Table 7: Capital and loss calculation for a subsample

Sample requirement	Rate refi, >=41 DTI, <=$50,000 Loan size, and single borrower
N	1811
base Capital	128
risk Cap	3.5
Gross Cap	385
Loss	239

3c: Mortgage Insurance and CRT

FHFA reduces capital requirements when a third party assumes some of the credit risk. We believe the reduction in capital requirements due to mortgage insurance (MI) are less than they should be given the changes in the business in the post crisis period.

The capital reduction as a result of MI is determined by LTV and loan age. For a 71<-=84 months loan with 90<-=95 percent LTV, cancellable MI loans is given capital credit of 15.5 percent (1-0.845) of the total capital charge; the credit is much higher on a new loan. There is a further haircut due to the counterparty risks. For a "3" rated non-diversified insurer, the haircut would be 0.083. Thus, the capital is only reduced by (1-0.845)*(1-0.083) or 14 percent.

We calculated that the average reduction in capital for mortgages with MI is 37 percent. Based on Urban Institute's calculation[1], for 2007 originations, the average severity for GSE MI loans is 34 percent, with 21 percent MI recovery. This implies a 38 percent (21/(34+21)) MI effectiveness.

It suggests that the proposed MI capital reduction is in line with the actual historical MI effectiveness. But this is not the right metric, as it does not take into account the changes in the industry. During the crisis, losses were incurred by the GSEs when some of the mortgage insurers were unable to pay their claims in full. PMIERs (Private Mortgage Insurance Eligibility Requirements) has sharply increased MI capital requirements; if the Great Financial Crisis were to repeat with these standards in place we would expect higher actual MI effectiveness. Moreover, the updated Master Policies have made it much more difficult for the Mis to curtail their insurance payouts. Given these enhancements, the proposal does not give enough credit for the mortgage insurance as a credit enhancer.

Similarly, the FHFA's calculations show credit risk transfers (CRT) transactions reduced the required capital by $21.5 billion as of September 2017. Based on outstanding bonds of approximately $50 billion, this (21.5/40) or 42 percent effectiveness seems in line with research by Mark Zandi et al.

[1] https://www.urban.org/sites/default/files/publication/92681/mortgage_insurance_data_at_a_glance_chartbook_4.pdf

There are two places where CRT is treated more generously than MI. First, under the CCF, the reduction in the required capital due to CRT does not diminish as the bonds near maturity, but rather the formula is based on original maturity of the bond. This seems counterintuitive as a bond with only one year remaining maturity provides much less protection than a bond with a 10 year maturity. The FHFA recognizes this in its treatment of cancellable MI. Second, the GSEs cede premium income for CRT credit enhancement, the GSEs do not foot the bill for MI. Under the CCF, there is no credit given for g-fee revenues, no ding if those revenues are not present.

In addition, under this CCF, there is no credit given for additional credit enhancement above the capital attachment point. That is, if the capital attachment point is 3%, and the GSE chooses to lay off 4% instead, they receive zero capital relief for what is clearly laying off risk.

3d: Refis

In general, FHFA proposal has a multiplier of 1.3 for rate and term refinanced mortgages and 1.4 for cash-out refinanced mortgages. Refinanced mortgages have tended in the past to perform worse than purchase loans, largely because the appraised LTV estimate in a refinancing is not as accurate as the LTV in an arm's length purchase transaction. Cash-out refis have tended to perform considerably worse, both due to an inaccurate LTV and because these borrowers are more likely to be cash constrained.

Table 8 shows the capital requirement and loss rate by FICO and LTV categories for both purchase and refi mortgages. Note that even with the multiplier, refis have 143/186=76 percent of the required capital levels of purchase loans. This is because refis tend to have much lower LTVs as equity has built up in the house since the original purchase. However, our loss estimates suggest that rather than for the current book, rather than a 76 percent, the capital charges should be less than 50 percent (81/170).

Table 8: Capital and loss for purchase, rate refi and cash-out refi

LTV	FICO	Capital			Loss		
		Purchase	Rate-Refi	Cash-out Refi	Purchase	Rate-Refi	Cash-out Refi
<75-80	640-<660	515	638	812	405	616	814
<90-95	640-<660	606	1030	1134	460	1160	943
<75-80	740<-760	131	170	233	405	68	131
<90-95	740<-760	197	222	294	131	64	173
AVERAGE, as of Dec, 2016		186	143	241	170	81	241

Recent Urban Institute research[2] shows that in the past, particularly in the pre-crisis years, the behavior of low LTV refinanced mortgages was very poor, suggesting the LTV was understated. With

[2] https://www.urban.org/sites/default/files/publication/97746/what_fueled_the_financial_crisis.pdf

improvements in the appraisal process instituted by the industry and the GSEs, appraisals are now more accurate. This would argue for a lower multiplier.

A look at the data confirms this. As shown in Table 9, there are "vintage effects": in 2011 and earlier the actual loss rates for purchase loans are much lower than for rate/term refis. In more recent years, the loss rates are similar for purchase and rate refi loans, because of improvements both in the appraisal process and in automated valuation models. process. We believe not using historical data only, and not overweighting recent history can cause the capital levels on rate/term refis to be unnecessarily high.

Table 9: Vintage Effects

Orig Year	Purchase	Rate Refi	Cash-out Refi	All
1999	0.15%	0.33%	0.51%	0.25%
2000	0.15%	0.59%	0.78%	0.27%
2001	0.24%	0.47%	0.58%	0.40%
2002	0.42%	0.61%	0.76%	0.59%
2003	0.74%	0.71%	0.93%	0.78%
2004	1.22%	1.48%	2.00%	1.51%
2005	2.55%	2.76%	3.86%	3.08%
2006	3.18%	4.60%	5.99%	4.43%
2007	2.78%	5.58%	6.02%	4.50%
2008	1.28%	2.28%	3.14%	2.10%
2009	0.20%	0.22%	0.40%	0.27%
2010	0.06%	0.09%	0.25%	0.12%
2011	0.03%	0.05%	0.15%	0.06%
2012	0.02%	0.02%	0.05%	0.02%
2013	0.01%	0.01%	0.04%	0.01%
2014	0.01%	0.01%	0.03%	0.01%
2015	0.00%	0.00%	0.00%	0.00%
2016	0.00%	0.00%	0.00%	0.00%
All	0.72%	0.83%	1.74%	1.02%

3e: Delinquency status

The Table 10 shows the capital requirement by delinquency status as of each exposure year. Using 2016 as an example, the performing loans have a very low requirement due to the several years of very robust house price appreciation. However, modified loans and delinquent loans have a very high requirement of 834 bps and 919 bps, in line with historical experience.

Table 10: Capital by exposure year

Year	New Origination Loan	Performing Seasoned Loan	Non-Modified Reperforming Lo	Modified Reperforming Loan	Non-Performing Loan	Capital
2002	312	211	413	784	896	300
2003	306	196	403	732	895	271
2004	289	152	338	649	853	215
2005	265	123	282	612	830	180
2006	273	137	296	615	877	186
2007	270	215	421	781	1056	262
2008	232	449	768	1103	1418	478
2009	193	472	890	1555	1583	547
2010	187	458	997	1841	1569	567
2011	205	408	995	1936	1623	539
2012	215	239	726	1716	1437	383
2013	251	145	459	1326	1385	255
2014	241	136	344	1134	1163	216
2015	248	129	285	971	1060	196
2016	249	125	257	834	919	186

Table 10 also shows that the capital requirements for the modified reperforming and non-performing categories tend to be relatively stable over time even though cure rates vary significantly over time.

Our one suggestion is to consider modifying the definition of non-performing loan to D60 or D90. For the purposes of this capital standard, a non-performing loan is defined as one that is D30 in the reporting quarter. This D30 definition introduces unnecessary volatility in the calculations: seasonality plays a larger role in D30 than in D60 or D90. Moreover, months that end on a Sunday tend to have higher D30s.

To illustrate the higher volatility, we calculate the percentage of loans in the non-performing category for each quarter from 2002 to 2016 for D30, D60 and D90. We then calculate the standard deviation for these three time series. The standard deviation is 1.02 percent for D30 definition, 0.9 percent for D60 and 0.8 percent for D90. As expected, defining non-performing as D30 introduces more volatility than the other two definitions. It should be noted that this imposes more of a penalty on low FICO borrowers, and may contribute to the overcapitalization we observed earlier, as they are more likely than their higher FICO counterparts to miss one payment, then catch.

To reduce volatility and to simplify the proposal, an alternative would be to key delinquency off D 90. Table 11 shows the new capital requirement using a D90 instead of a D30 definition for the non-performing loans. The average capital requirement is very similar to what we have before. However, the requirement would have less volatility and would be less likely to penalize borrowers who occasionally miss a payment.

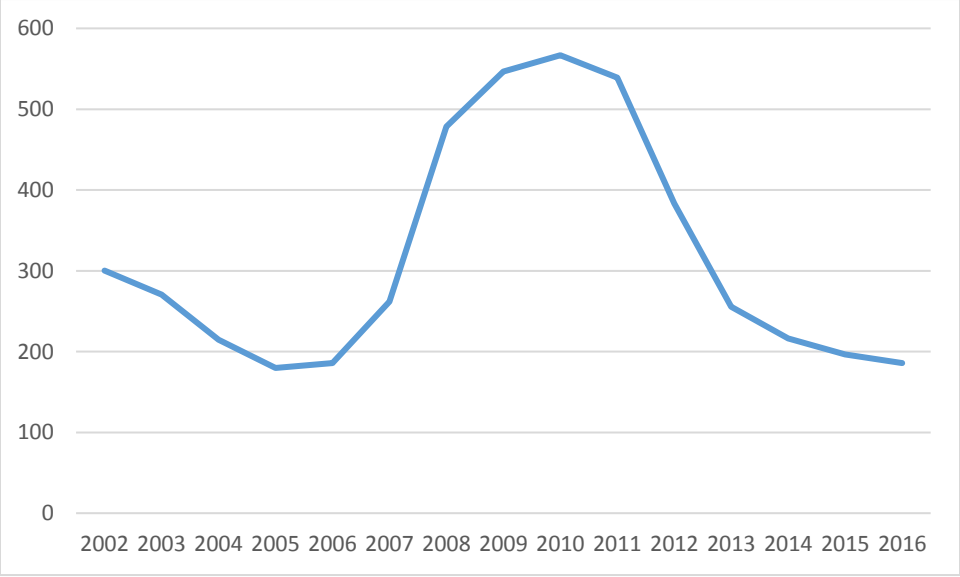
Table 11: Experiment Changing D30=> D90

FICO/LTV	<=30%	<30-60%	<60-70%	<70-75%	<75-80%	80<-85%	85<-90%	90<-95%	95<-97%	All
<620	349	385	603	767	782	858	959	1084	1120	851
620 - <640	132	194	334	470	582	709	721	726	879	598
640 - <660	114	156	274	394	487	630	589	587	690	502
660 - <680	78	122	215	293	390	517	480	453	581	404
680 - <700	59	94	161	239	328	418	385	379	494	344
700 - <720	47	71	132	184	249	329	299	297	420	268
720 - <740	30	60	105	148	203	267	241	245	347	221
740 - <760	33	47	85	116	158	211	191	193	274	174
760 - <780	22	35	61	89	121	158	145	151	215	130
>=780	17	24	43	63	87	114	104	108	155	86
All	30	47	89	121	167	225	205	220	316	181

4: Capital and the business cycle

Most of the results in section 3 focused on the capital requirement as of 2016. However, the housing environment was very benign at that time with house price appreciation averaging about 7 percent per year. Yet when a GSE is purchasing a mortgage it cannot count on such a benign environment. To illustrate, we compute the capital requirement for each year since 2002, as shown in Figure 1. The capital requirement ranges between just under 2 percent and almost 6 percent. And the requirement can double in as little as 2 years (between 2006 and 2008). This level of pro-cyclicality is quite dramatic.

Figure 1: Capital requirement by exposure year



It is difficult for the GSEs to plan for this. As a simple exercise, assume that that the average of 3% occurs half the time; bad times of 6% occurs a quarter of the time; and good time of 2% occur a quarter of the time. The expected capital requirement and what a GSE might plan on would be 3.5% or significantly higher than today's 2%. And remember that this is just one component of the capital when the GSEs purchase a mortgage. The operational risk and going concern buffer adds another 0.82% bringing the total capital requirement to about 4.3%. Add on another operational cushion and the GSEs might have to operate around 5% or more under this capital standard. Note that the capital standard can be lowered somewhat by use of CRTs. Currently the GSEs reduce the capital standard by about a half a percent and we estimate that this could grow to about 1%. But CRTs are not cost free either, as they give up guarantee fee income.

The pro-cyclicality issue is not just that the GSEs would have trouble managing capital, particularly once they are out of conservatorship. The more important issue is that, to the extent it is reflected in pricing, g-fees decline at exactly the wrong time. Figure 1 shows that the lowest capital was required to be held in 2005 and 2006. Assuming g-fees price in the cost of capital, the g-fees would have been lowest in the run up to the crisis. This is exactly the wrong result from a public policy point of view.

Section 5: Discussion

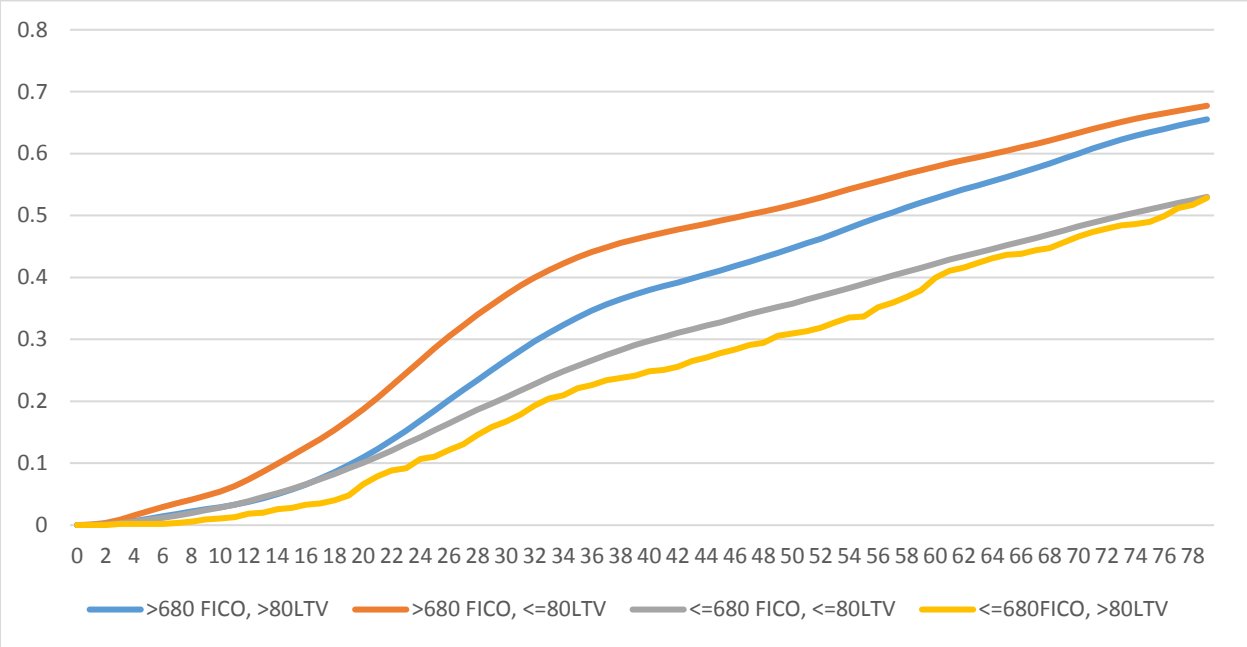
The capital proposal is quite detailed and aligns capital with risk in many aspects. We find that for certain higher risk mortgages the proposal is overly conservative. In particular, mortgages with low FICO, mortgage insurance (high LTV mortgages), and layered risk are likely to result in too high of a capital charge. And these issues are further exacerbated by the very pro-cyclical nature of the requirement. It will be difficult for a GSE to manage to a requirement that can double in two years. And this issue hits higher risk mortgages more as doubling from 1 percent requirement to 2 percent for a low risk loan is not as problematic as doubling from 4 percent to 8 percent. Consequently, we are concerned that this proposal will limit access to credit for potential new homebuyers who on average are higher risk, but still very creditworthy. And we are very concerned that it will result in the extension of credit at exactly the wrong point in the cycle.

Three modeling assumptions may have driven some of these results. First, FHFA explicitly decided not to incorporate guarantee fee into the analysis. Most regulators do not include future income as it is difficult to forecast and often disappears in times of stress. Guarantee fee income is different in that it is an interest only strip on mortgages owned by the GSEs. It is totally unreasonable to assume 100% of these mortgages default or prepay immediately. So why not include a conservative estimate of future g-fee income? Doing so would disproportionately benefit the higher risk mortgages that pay higher g-fees. Put another way, if the GSEs are going to implement more granular risk-based pricing to more finely assess price for perceived risk, the higher risk mortgagees should at least get the benefit of what they are paying for.

Second, FHFA did not try to incorporate improvements in the mortgage market since the Great Recession into their modeling. From improved appraisals, to verification of income, to stronger capitalization of Mis, there have significant improvements in the mortgage origination and underwriting processes. These improvements show up in lower early payment defaults and can be tracked. Understandably regulators are reluctant to incorporate improvements that can evaporate quickly into capital standards. But again, giving no credit penalizes higher risk mortgages more.

Third, FHFA used a very granular risk based approach on credit risk, but imposes a flat capital charge for prepayment risk. Prepayment risk affects not only the debt funded mortgages in the GSE portfolios but also aspects of the securitization business such as future g-fee income, float, and security performance. As figure 2 shows, mortgages with higher credit risk (low FICO, high LTVs) are less likely to prepay and hence less likely to create prepayment risk for the GSEs. This means that the g-fee income from these mortgages is both a longer and a more stable cash flow stream. A fuller risk-based approach to prepayment risk would result in a modification to this proposal to reflect higher capital charges on those mortgages with low credit risk and lower capital charges for those mortgages with higher credit risk.

Figure 2: Prepayment Fingers for 2010 purchase originations



Incorporating these three factors into the risk based capital standards would better align capital with risk and would also meet the policy objective of providing credit worthy borrowers with affordable homeownership opportunities.

Besides better aligning capital with risk, FHFA should also consider ways of reducing the volatility of the requirement over the cycle, while giving the market certainty. The FHFA has the ability to exercise discretion under the Federal Housing Enterprises Financial Safety and Soundness Act of 1992; it can alter and of the capital components. But is not always obvious ex-ante when that discretion should be employed, and it is hard for the market to gauge when it would be employed. Simple approaches to address the volatility of the requirement over the cycle would be to set minimums and maximums on the risk-based requirement. The FHFA of course has the ability to impose capital directives if risk was unreasonable. Another approach would be to have the risk-based requirement (as a percentage of the assets) be a moving average of the model results for the last 2 years. Relying on original LTV is another possibility. In short, something needs to be done to limit the effects of cyclical nature of the standard while still preserving its ability to align capital with risk.

While the FHFA proposal is a step forward, the above analysis suggests improvements could be made to meet the two goals of protecting the taxpayer and promoting sustainable homeownership.