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Market Commentary – Intended for Institutional Clients Only. This communication has been prepared by Markets Quantitative Analysis (“MQA”), which is part of Citigroup Global Markets’ sales and trading operations.

Agency RMBS Prepayment Model Release of Model v21.7 on Yield Book

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Highlights of Major Model Updates from v21.6 to v21.7

Continued COVID-19 Impact

- P/S spread baseline 90-95 bps, dropping to 80 bps (5 bps under approx. LT average) by end of 2022
- Incorporate forbearance and post-forbearance modification policy updates from FHFA/GSEs/FHA/GNMA
- Increase certain non-bank buyout rates (e.g., Lakeview, PennyMac) based on history over recent months
- FHFA AMRF terminated per Jul 16 announcement; assume 50% impact in Aug and full impact in Sep 2021
- HPA base case adjusted to 17% in 2021 (+20% Q2-Q3, +12.5% Q4) and 3% in 2022 and thereafter
- Unemployment from Jun Fed forecast: 6% now to ~4.5% Q4, then 3.8%/3.5% by Q4 2022/2023, 4% long run
- Incorporate GSE RefiNow / RefiPossible programs for low income owner-occupied loans
- Add coverage for RG/I5/I6 pools and account generally for impact of payment deferrals on incentives
- Elevated curtailments from mid-2020 thru 2021 from higher savings and government stimulus payments
- Very strong cash-out refinancings expected if the home price gains unprecedented since World War II hold up

P/S Spread and Other Rate Sub-Model Updates

- Spread more sensitive to rally/backup at high media effect levels, further reducing primary rate volatility
- Currently, no changes in g-fees (TCCA or FHFA) assumed, but TCCA expiration at year-end is possible
- Extension of 10bps TCCA may be a revenue source for affordable housing (noted by NAR, Urban Institute)
- But it may also be extended in light of government efforts to fund dramatically increased spending overall
- The likelihood of extension became much higher after its inclusion in a bipartisan Senate infrastructure bill
- P/S spread decline further slowed during very strong rallies when capacity expansion may be more difficult
- G2/FN swap correlation to primary GNMA/conv. rates set to 50% for now, review of relationship is ongoing
- 30yr to 15yr/5x1 spreads now based on 10yr to 5yr CMT instead of swap spread, due to LIBOR replacement

Recalibrated Refi Response – PIW, Media Effect, Burnout

- Conventional refi ramps further converted from peak to plateau, based on recent major/multi pool speeds
- PIW / media effect / burnout recalibrated, better matching strength and coupon/seasoning distribution of speeds
- Burnout/media effect interaction: media effect accelerates burnout and is weaker on burned out collateral
- Add initial PIW as driver of refinances; differences between PIW and non-PIW not fully explained otherwise

Conventional 30yr Generic Comparisons: v21.7 vs. v21.6

Curve Date: 7/28/2021					1 Yr Proj			LT Proj			OAS			Eff Duration			Eff Convexity				
Coupon	Vintage	Tranche	Level	Payout	Age	WAC	Old	New	Diff	Old	New	Diff	Old	New	Diff	Old	New	Diff	Old	New	Diff
1.5	TBA	98.75	0	1	2.51	3.1	5.4	2.3	8.0	9.8	1.8	-18.7	-19.9	-1.2	6.1	5.8	-0.3	-2.6	-3.0	-0.4	
2.0	TBA	101.72	0	3	2.85	7.4	15.0	7.6	11.1	15.6	4.5	-10.6	-15.4	-4.8	4.6	4.0	-0.6	-3.2	-3.8	-0.5	
2.5	TBA	103.97	0	6	3.26	16.3	27.9	11.6	15.6	20.4	4.8	2.2	-8.8	-10.9	3.4	2.5	-0.9	-3.5	-3.3	0.2	
3.0	TBA	104.82	0	12	3.77	26.3	37.0	10.7	18.6	23.9	5.2	31.7	13.1	-18.6	2.7	1.8	-1.0	-2.7	-2.3	0.3	
3.5	TBA	105.98	0	23	4.33	27.2	39.0	11.7	21.9	30.5	8.7	50.2	12.9	-37.4	2.0	0.6	-1.4	-2.5	-2.0	0.6	
4.0	TBA	106.86	0	29	4.76	29.1	40.0	10.9	24.0	32.3	8.3	72.0	26.0	-46.0	1.7	0.5	-1.2	-2.0	-1.2	0.8	
4.5	TBA	107.82	0	32	5.15	28.8	38.2	9.4	24.2	30.9	6.7	96.0	50.9	-45.1	1.8	0.7	-1.0	-1.5	-0.9	0.6	
2.0	2020 GEN (ex-spec)	101.72	0	10	2.93	11.3	27.0	15.7	13.1	20.4	7.2	-15.2	-23.5	-8.3	3.9	2.9	-1.1	-4.0	-4.4	-0.3	
2.5	2020 GEN (ex-spec)	103.97	0	13	3.38	25.6	43.0	17.4	19.1	28.8	9.7	-13.4	-38.8	-25.4	2.2	0.7	-1.5	-3.9	-3.0	0.9	
3.0	2020 GEN (ex-spec)	104.82	0	15	3.86	30.8	46.0	15.2	22.9	34.8	11.9	15.4	-20.8	-36.2	1.8	0.1	-1.6	-3.1	-2.1	1.0	
3.0	2019 GEN (ex-spec)	104.82	0	22	3.91	28.3	45.0	16.6	22.1	34.9	12.7	19.9	-17.7	-37.6	1.9	0.3	-1.5	-3.3	-1.3	2.0	
3.0	2016 GEN (ex-spec)	104.82	0	59	3.64	21.4	31.9	10.5	17.1	22.0	4.9	38.6	19.7	-19.0	2.7	1.5	-1.2	-2.9	-3.1	-0.2	
3.0	2013 GEN (ex-spec)	104.82	0	99	3.57	18.6	28.0	9.4	15.8	19.9	4.0	47.8	31.1	-16.8	2.8	1.9	-1.0	-2.6	-2.9	-0.3	
3.0	2012 GEN (ex-spec)	104.82	0	105	3.58	19.0	28.8	9.9	16.1	20.5	4.4	47.3	29.3	-18.1	2.7	1.8	-1.0	-2.6	-2.9	-0.2	
3.5	2019 GEN (ex-spec)	105.98	0	24	4.44	33.8	48.8	14.9	27.2	39.8	12.6	30.1	-27.7	-57.8	1.3	-0.3	-1.6	-2.3	-0.8	1.5	
3.5	2017 GEN (ex-spec)	105.98	0	48	4.05	25.9	38.3	12.4	20.3	27.8	7.6	53.5	20.9	-32.6	2.0	0.6	-1.4	-2.7	-1.6	1.1	
3.5	2016 GEN (ex-spec)	105.98	0	61	4.10	24.4	34.2	9.9	19.2	24.9	5.7	60.2	33.1	-27.1	2.3	0.9	-1.4	-2.4	-2.8	-0.4	
3.5	2015 GEN (ex-spec)	105.98	0	72	4.11	23.0	33.4	10.4	18.8	24.6	5.8	62.3	35.4	-26.9	2.3	1.1	-1.3	-2.5	-2.5	0.0	
3.5	2013 GEN (ex-spec)	105.98	0	96	4.01	20.4	29.1	8.8	16.9	21.3	4.4	71.1	48.9	-22.2	2.6	1.5	-1.1	-2.3	-2.8	-0.4	
4.0	2019 GEN (ex-spec)	106.86	0	26	4.90	35.6	49.5	13.9	29.1	40.4	11.3	45.6	-27.3	-72.9	1.2	-0.4	-1.6	-1.6	-0.7	0.8	
4.0	2018 GEN (ex-spec)	106.86	0	36	4.66	33.0	47.3	14.3	26.5	37.4	10.9	57.5	-6.8	-64.3	1.2	-0.3	-1.5	-2.0	-0.4	1.7	
4.0	2017 GEN (ex-spec)	106.86	0	48	4.47	28.2	39.9	11.7	22.6	30.1	7.5	76.4	32.9	-43.5	1.8	0.2	-1.6	-2.1	-2.0	0.1	
4.0	2014 GEN (ex-spec)	106.86	0	85	4.60	23.0	32.1	9.1	20.1	25.4	5.3	91.1	61.1	-29.9	2.2	1.2	-1.1	-2.0	-2.1	-0.1	
4.0	2010 GEN (ex-spec)	106.86	0	129	4.49	20.5	28.5	8.0	19.0	23.7	4.7	95.0	69.9	-25.1	2.3	1.6	-0.7	-1.7	-1.4	0.3	
4.5	2019 GEN (ex-spec)	107.82	0	27	5.38	35.8	47.5	11.7	29.4	38.4	9.1	61.2	-11.0	-72.2	1.4	0.2	-1.2	-1.0	-0.9	0.1	
4.5	2018 GEN (ex-spec)	107.82	0	35	5.21	34.3	46.5	12.2	27.9	37.0	9.1	71.1	-1.1	-72.3	1.5	0.0	-1.5	-1.1	-1.2	0.0	
4.5	2011 GEN (ex-spec)	107.82	0	122	4.93	21.4	28.3	6.9	19.8	24.1	4.2	118.1	91.4	-26.6	2.3	1.6	-0.6	-1.3	-1.0	0.3	
4.5	2010 GEN (ex-spec)	107.82	0	134	4.93	22.4	29.3	6.9	20.7	25.0	4.3	111.3	83.4	-27.9	2.1	1.5	-0.6	-1.3	-0.9	0.4	
5.0	2018 GEN (ex-spec)	109.43	0	35	5.75	34.3	43.3	9.0	27.9	34.3	6.4	67.9	6.6	-61.3	1.7	0.7	-0.9	-0.7	-0.9	-0.3	

- One-year CPR projections on conventional 30yr TBAs and generic collateral increase dramatically in line with recent actuals, driven by model changes related to media effect and refinancing efficiency. Longer term projections are also higher, driven by much stronger short-term speeds factoring into the average-life equivalent LT calculation, as well as strong cash-outs from high HPA and a slightly higher S-curve on fully burned out collateral.
- OAS and duration decrease as expected, given the higher overall refinancing speeds and stronger media effect. Convexity is a bit more negative on 1.5s and 2s for the same reason. Convexity does decline on higher coupons, which are modeled in v21.7 as paying close to the top of the S-curve.

Conventional 30yr Spec Pool Comparisons: v21.7 vs. v21.6

Coupon Tranche	Curve Date: 7/28/2021					1 Yr Proj CPR			LT Proj CPR			OAS			Eff Duration			Eff Convexity		
	Level	Payup	Age	WAC		Old	New	Diff	Old	New	Diff	Old	New	Diff	Old	New	Diff	Old	New	Diff
2.0	2020 LLB	102.59	28	8	2.62	5.7	8.8	3.2	8.5	9.9	1.4	9.5	7.7	-1.8	6.3	5.8	-0.4	-1.1	-1.2	-0.2
2.0	2020 MLB	102.41	22	8	2.72	6.4	10.2	3.8	9.1	10.8	1.7	6.3	3.0	-3.3	5.7	5.2	-0.6	-1.5	-1.8	-0.3
2.0	2020 HLB	102.28	18	9	2.79	7.0	12.0	5.0	9.9	12.1	2.3	2.0	-2.9	-4.9	5.3	4.6	-0.7	-2.0	-2.4	-0.4
2.0	2020 HHLB	102.16	14	9	2.84	7.0	12.3	5.4	10.1	12.7	2.6	1.4	-4.3	-5.7	5.2	4.4	-0.8	-2.2	-2.7	-0.5
2.0	2020 MAX200K	102.03	10	9	2.89	7.3	13.2	5.9	10.3	13.3	3.0	0.6	-5.7	-6.2	5.0	4.1	-0.9	-2.4	-2.9	-0.6
2.0	2020 NY	102.09	12	9	2.87	4.3	7.5	3.2	7.8	9.4	1.6	-3.0	-7.9	-4.9	6.1	5.3	-0.7	-2.4	-3.1	-0.7
2.0	NEW	101.72	0	1	2.90	7.1	16.5	9.4	12.1	18.1	6.0	-16.4	-22.7	-6.3	4.4	3.7	-0.7	-3.5	-3.8	-0.4
2.5	2020 LLB	105.91	62	10	3.06	7.9	11.7	3.8	10.1	11.6	1.6	9.3	3.8	-5.4	5.4	4.9	-0.5	-1.3	-1.4	-0.1
2.5	2020 MLB	105.59	52	10	3.10	8.7	13.4	4.6	10.8	12.7	2.0	5.9	-2.0	-7.9	4.9	4.2	-0.7	-1.8	-2.1	-0.2
2.5	2020 HLB	105.28	42	10	3.17	9.6	15.5	5.9	11.7	14.3	2.7	2.4	-8.4	-10.8	4.3	3.4	-0.9	-2.3	-2.7	-0.4
2.5	2020 HHLB	105.09	36	11	3.29	10.7	19.6	8.9	12.7	16.6	4.0	-0.7	-16.2	-15.6	3.9	2.7	-1.2	-2.7	-3.2	-0.5
2.5	2020 MAX200K	104.78	26	11	3.38	12.3	22.4	10.1	13.5	18.0	4.6	-0.3	-17.2	-16.8	3.6	2.4	-1.3	-3.0	-3.4	-0.4
2.5	2020 NY	105.06	35	11	3.30	6.8	12.5	5.7	9.9	12.7	2.7	1.8	-8.9	-10.7	4.7	3.6	-1.1	-3.1	-4.1	-0.9
2.5	NEW	103.97	0	1	3.30	15.1	26.4	11.3	17.4	24.3	6.9	-6.5	-19.9	-13.3	3.1	2.2	-1.0	-3.5	-3.3	0.2
3.0	2020 LLB	108.82	128	12	3.52	9.7	14.3	4.6	11.3	13.1	1.8	10.7	0.5	-10.2	4.8	4.2	-0.5	-1.4	-1.4	0.0
3.0	2020 MLB	108.07	104	12	3.55	11.2	17.0	5.7	12.4	14.7	2.4	11.3	-2.7	-14.1	4.1	3.3	-0.8	-1.9	-2.1	-0.2
3.0	2020 HLB	107.57	88	13	3.61	13.5	21.4	7.9	13.8	17.2	3.4	7.4	-12.5	-19.9	3.4	2.3	-1.1	-2.5	-2.8	-0.3
3.0	2020 HHLB	106.88	66	14	3.72	15.6	26.3	10.7	15.0	19.8	4.7	10.8	-14.7	-25.5	3.0	1.6	-1.4	-2.7	-2.9	-0.2
3.0	2020 MAX200K	106.01	38	15	3.83	19.2	31.5	12.3	16.5	22.7	6.2	18.0	-10.7	-28.8	2.7	1.2	-1.5	-2.8	-2.8	0.1
3.0	2020 NY	107.45	84	14	3.70	13.2	22.3	9.1	12.8	16.3	3.5	6.5	-15.0	-21.5	3.3	1.8	-1.6	-3.5	-4.0	-0.5
3.0	NEW	105.51	22	1	3.87	25.8	34.8	9.0	23.0	30.3	7.3	6.3	-15.8	-22.2	2.1	1.2	-0.9	-2.5	-1.9	0.6
3.0	2019 LLB	108.82	128	21	3.65	12.2	17.3	5.1	12.1	14.1	2.0	4.6	-7.5	-12.2	4.4	3.8	-0.6	-1.6	-1.6	-0.1
3.0	2019 MLB	108.07	104	21	3.69	14.0	20.3	6.3	13.4	16.1	2.7	4.7	-12.2	-16.8	3.7	2.8	-0.9	-2.1	-2.4	-0.3
3.0	2019 HLB	107.57	88	21	3.78	17.3	26.3	9.0	15.1	19.3	4.2	0.1	-25.4	-25.5	3.0	1.7	-1.3	-2.6	-2.9	-0.3
3.0	2019 HHLB	106.88	66	21	3.81	18.7	30.5	11.9	16.1	21.9	5.8	4.9	-27.4	-32.3	2.6	1.0	-1.6	-2.9	-3.0	-0.2
3.0	2019 MAX200K	106.01	38	21	3.82	20.0	32.9	12.9	16.6	23.4	6.8	17.0	-15.6	-32.6	2.6	0.9	-1.7	-3.0	-3.2	-0.2
3.0	2019 NY	107.45	84	21	3.72	13.8	23.0	9.2	12.6	16.1	3.5	7.4	-15.9	-23.3	3.2	1.5	-1.7	-3.5	-4.2	-0.8
3.5	2019 LLB	110.98	160	22	4.03	14.2	19.3	5.0	13.1	15.1	2.0	11.8	-4.3	-16.0	3.8	3.2	-0.6	-1.6	-1.6	0.0
3.5	2019 MLB	109.85	124	22	4.08	16.9	23.5	6.6	14.7	17.7	2.9	14.7	-8.6	-23.3	3.1	2.1	-1.0	-2.0	-2.3	-0.3
3.5	2019 HLB	109.29	106	23	4.23	20.8	30.5	9.7	17.1	22.0	4.9	7.2	-29.6	-36.8	2.3	0.8	-1.4	-2.4	-2.4	-0.1
3.5	2019 HHLB	108.48	80	23	4.33	22.2	34.3	12.0	18.4	25.0	6.6	14.7	-29.8	-44.5	2.1	0.3	-1.7	-2.5	-2.4	0.1
3.5	2019 MAX200K	107.29	42	24	4.35	23.7	36.6	12.9	19.3	27.2	7.9	33.1	-11.0	-44.1	2.1	0.3	-1.7	-2.5	-2.3	0.3
3.5	2019 NY	109.41	110	23	4.15	18.5	27.0	8.5	14.3	18.4	4.2	18.9	-13.0	-32.0	2.7	0.8	-1.9	-3.0	-3.9	-0.9
3.5	NEW	106.66	22	1	4.33	26.8	35.0	8.1	25.0	31.2	6.2	27.3	0.0	-27.3	1.8	1.0	-0.8	-1.7	-1.2	0.4

- Changes in the 30yr spec pool sector largely mirror changes in generics overall, although sectors with the most call protection (e.g., MLB/LLB) are not affected as much.
- The high dollar prices combined with the model changes drive significantly negative OASs and short durations on higher coupon, higher loan balance segments. Many of these borrowers are eligible for RefiNow or RefiPossible, which reduces costs and opens the credit box.

Conventional 15yr Comparisons: v21.7 vs. v21.6

Curve Date: 7/28/2021							1 Yr Proj CPR			LT Proj CPR			OAS			Eff Duration			Eff Convexity		
Coupon	Vintage	Tranche	Level	Payup	Age	WAC	Old	New	Diff	Old	New	Diff	Old	New	Diff	Old	New	Diff	Old	New	Diff
1.5	TBA	101.69	0	1	2.20		9.7	14.4	4.7	12.5	15.4	2.9	-20.0	-21.4	-1.4	3.5	3.3	-0.2	-1.8	-1.9	-0.1
2.0	TBA	103.67	0	3	2.55		14.8	20.0	5.2	15.7	18.1	2.4	-15.7	-19.3	-3.6	2.9	2.7	-0.2	-2.0	-1.9	0.1
2.5	TBA	104.78	0	12	3.07		22.7	28.3	5.6	19.7	21.6	2.0	-4.0	-10.9	-7.0	2.1	1.9	-0.2	-1.8	-1.5	0.2
3.0	TBA	105.24	0	17	3.63		25.1	29.4	4.3	21.1	22.6	1.5	25.6	17.5	-8.2	2.0	1.8	-0.2	-1.4	-1.3	0.1
3.5	TBA	106.89	0	26	4.13		26.8	30.1	3.3	22.7	23.6	1.0	11.1	0.2	-10.9	1.4	1.2	-0.3	-1.4	-1.5	-0.1
1.5	2020 GEN (ex-spec)	101.69	0	9	2.26		15.2	24.2	9.0	15.0	19.4	4.4	-19.8	-22.8	-2.9	3.0	2.6	-0.3	-2.4	-2.5	-0.1
2.0	2020 GEN (ex-spec)	103.67	0	11	2.67		24.0	33.1	9.0	20.6	25.0	4.4	-29.4	-38.8	-9.4	1.8	1.5	-0.3	-2.5	-2.0	0.5
2.0	2013 GEN (ex-spec)	103.67	0	99	2.61		16.7	19.4	2.8	16.9	18.9	2.0	-27.0	-31.6	-4.6	1.9	1.8	-0.1	-0.6	-0.5	0.1
2.5	2020 GEN (ex-spec)	104.78	0	14	3.12		29.6	37.2	7.6	24.4	28.2	3.7	-22.8	-35.1	-12.3	1.2	1.0	-0.2	-2.1	-1.4	0.7
2.5	2019 GEN (ex-spec)	104.78	0	21	3.14		29.3	37.0	7.7	24.1	28.3	4.1	-21.9	-34.6	-12.7	1.2	1.0	-0.2	-1.9	-1.5	0.5
2.5	2016 GEN (ex-spec)	104.78	0	59	2.95		19.6	24.8	5.2	18.5	20.7	2.1	-8.4	-16.8	-8.4	1.8	1.6	-0.2	-1.4	-1.3	0.1
3.0	2017 GEN (ex-spec)	105.24	0	48	3.43		24.7	30.0	5.3	21.7	23.6	1.9	15.1	5.2	-10.0	1.5	1.3	-0.2	-1.5	-1.0	0.5
3.0	2015 GEN (ex-spec)	105.24	0	72	3.47		20.9	24.6	3.7	19.3	20.9	1.6	15.6	7.8	-7.8	1.8	1.6	-0.2	-1.0	-1.1	-0.1
3.0	2012 GEN (ex-spec)	105.24	0	110	3.45		18.2	20.9	2.7	18.1	20.6	2.5	-24.2	-33.9	-9.7	1.6	1.5	-0.1	-0.5	-0.4	0.0
3.5	2018 GEN (ex-spec)	106.89	0	37	4.07		31.8	37.7	5.9	26.5	29.4	2.8	-17.4	-38.2	-20.8	0.8	0.6	-0.3	-1.3	-0.3	0.9
3.5	2011 GEN (ex-spec)	106.89	0	122	3.90		18.4	21.6	3.2	18.9	22.2	3.3	-100.6	-118.9	-18.3	1.4	1.3	-0.1	-0.4	-0.4	0.0
2.0	2020 LLB	104.23	18	9	2.53		9.4	11.4	2.1	11.5	12.3	0.8	-4.0	-5.5	-1.5	3.9	3.8	-0.1	-0.6	-0.5	0.1
2.0	2020 MLB	104.17	16	9	2.56		10.4	12.7	2.3	12.1	13.0	0.9	-7.8	-9.6	-1.8	3.6	3.5	-0.1	-1.0	-1.0	0.0
2.0	2020 HLB	104.07	13	10	2.58		12.0	15.8	3.7	13.3	14.8	1.4	-12.8	-16.2	-3.4	3.2	3.0	-0.2	-1.5	-1.5	0.0
2.0	2020 HHBLB	103.98	10	10	2.59		12.4	17.6	5.2	13.8	15.9	2.1	-14.3	-19.7	-5.3	3.0	2.7	-0.3	-1.8	-1.8	0.0
2.0	2020 MAX200K	103.92	8	10	2.60		13.1	18.9	5.8	14.1	16.6	2.6	-15.2	-22.1	-6.9	2.8	2.4	-0.4	-2.0	-2.1	-0.1
2.0	2020 NY	104.04	12	9	2.57		7.6	11.4	3.8	9.6	11.3	1.7	-6.4	-10.1	-3.7	3.6	3.4	-0.3	-1.7	-1.9	-0.1
2.0	NEW	103.70	1	1	2.54		16.0	21.2	5.2	17.4	20.4	3.0	-23.4	-27.7	-4.3	2.5	2.3	-0.2	-2.2	-2.1	0.2
2.5	2020 LLB	106.22	46	12	2.98		10.7	13.1	2.4	12.4	13.4	1.0	-2.8	-6.2	-3.4	3.6	3.5	-0.1	-0.7	-0.6	0.1
2.5	2020 MLB	106.03	40	12	2.99		12.3	15.3	3.0	13.4	14.6	1.2	-5.6	-10.1	-4.5	3.2	3.1	-0.1	-1.1	-1.0	0.1
2.5	2020 HLB	105.84	34	12	3.01		14.9	19.0	4.1	15.2	16.8	1.6	-11.6	-18.1	-6.5	2.7	2.4	-0.2	-1.6	-1.6	0.0
2.5	2020 HHBLB	105.66	28	12	3.02		15.9	21.6	5.6	16.1	18.4	2.3	-12.8	-22.1	-9.3	2.4	2.0	-0.3	-1.9	-1.8	0.0
2.5	2020 MAX200K	105.41	20	13	3.03		17.4	23.9	6.4	16.9	19.7	2.8	-11.5	-22.8	-11.4	2.1	1.7	-0.4	-2.1	-2.0	0.1
2.5	2020 NY	105.84	34	12	2.96		10.7	15.4	4.7	11.6	13.7	2.0	-1.2	-7.7	-6.5	3.0	2.7	-0.3	-1.9	-2.0	0.0
2.5	NEW	105.22	14	1	3.03		21.3	25.6	4.2	21.0	23.5	2.5	-19.5	-27.3	-7.7	1.9	1.7	-0.2	-1.9	-1.7	0.3
3.0	2019 LLB	107.68	78	21	3.49		13.7	16.2	2.5	14.3	15.3	1.0	-0.9	-5.9	-5.1	3.1	3.0	-0.1	-0.7	-0.6	0.1
3.0	2019 MLB	107.30	66	21	3.51		16.4	19.4	3.0	16.1	17.3	1.2	-3.5	-10.1	-6.5	2.6	2.4	-0.1	-1.1	-1.1	0.1
3.0	2019 HLB	106.93	54	21	3.53		19.9	23.9	4.0	18.3	20.0	1.7	-7.2	-17.2	-9.9	2.0	1.7	-0.3	-1.6	-1.5	0.0
3.0	2019 HHBLB	106.68	46	21	3.53		21.5	26.7	5.2	19.6	21.8	2.2	-8.4	-21.6	-13.2	1.7	1.3	-0.3	-1.8	-1.7	0.2
3.0	2019 MAX200K	106.36	36	21	3.55		23.1	29.4	6.3	20.7	23.6	2.9	-5.9	-23.4	-17.4	1.4	1.0	-0.5	-2.0	-1.7	0.3
3.0	2019 NY	106.96	55	22	3.52		17.7	22.5	4.8	15.5	17.5	2.0	4.0	-7.7	-11.7	2.2	1.8	-0.4	-1.8	-1.9	0.0
3.0	NEW	105.86	20	1	3.71		18.8	21.8	3.0	19.1	20.1	1.0	24.6	19.5	-5.1	2.5	2.3	-0.2	-1.1	-1.1	0.0

- Changes in the 15-year sector are directionally similar to those in the 30-year sector, but are typically smaller in magnitude. In general, 15-year collateral has not been as sharply out of line with the prior model as the 30-year sector, despite the relevance of PIW and media effect (15-year collateral is generally made up of higher quality refi loans). Thus we have moderated the overall S-curve vs. 30yr loans, although we do observe more inconsistency in quality-of-fit in the 15-year sector as compared to the 30-year sector.

GNMA II 30yr Generic Comparisons: v21.7 vs. v21.6

Curve Date: 7/28/2021							1 Yr Proj CPR			LT Proj CPR			OAS			Eff Duration			Eff Convexity		
Coupon	Vintage	Tranche	Level	Payup	Age	WAC	Old	New	Diff	Old	New	Diff	Old	New	Diff	Old	New	Diff	Old	New	Diff
1.5	TBA		99.29	0	1	1.95	4.3	8.6	4.4	9.2	10.6	1.4	-12.6	-12.7	-0.1	5.3	5.1	-0.2	-2.8	-2.6	0.2
2.0	TBA		102.09	0	1	2.38	10.8	14.8	4.0	13.2	16.4	3.3	-14.4	-18.3	-3.9	3.8	3.5	-0.4	-3.3	-3.4	-0.1
2.5	TBA		103.69	0	3	2.90	26.8	32.9	6.1	20.6	26.0	5.4	2.8	-7.3	-10.2	2.8	2.1	-0.6	-3.0	-2.8	0.1
3.0	TBA		104.49	0	6	3.38	35.1	40.4	5.3	24.8	29.3	4.5	27.5	15.1	-12.4	2.0	1.5	-0.4	-2.0	-1.5	0.5
3.5	TBA		105.05	0	10	3.91	38.6	44.4	5.8	26.8	31.2	4.4	56.6	39.2	-17.4	2.0	1.7	-0.3	-1.2	-0.8	0.3
4.0	TBA		105.91	0	16	4.49	39.0	48.2	9.2	30.6	36.2	5.6	67.7	30.9	-36.8	1.7	1.2	-0.4	-0.8	-0.5	0.4
4.5	TBA		106.63	0	19	4.96	37.7	47.3	9.5	31.3	35.9	4.6	90.9	53.4	-37.5	1.9	1.4	-0.5	-0.4	-0.2	0.2
2.0	2020 GEN (ex-spec)		102.09	0	9	2.43	18.9	32.2	13.3	15.4	21.4	6.0	-16.3	-24.5	-8.1	3.1	2.3	-0.8	-4.4	-3.9	0.5
2.5	2020 GEN (ex-spec)		103.69	0	11	2.92	36.7	49.9	13.2	22.9	33.2	10.3	-9.1	-34.2	-25.1	1.8	0.8	-0.9	-3.3	-2.0	1.3
3.0	2020 GEN (ex-spec)		104.49	0	15	3.47	35.3	49.2	13.9	24.5	34.6	10.1	27.4	-7.4	-34.8	2.1	1.1	-1.0	-2.1	-1.4	0.7
3.0	2019 GEN (ex-spec)		104.49	0	21	3.51	30.1	46.8	16.7	22.5	33.0	10.5	34.7	-3.5	-38.1	2.3	1.1	-1.2	-2.3	-1.6	0.6
3.0	2016 GEN (ex-spec)		104.49	0	59	3.41	25.3	36.4	11.1	17.8	24.1	6.2	52.1	26.1	-26.0	3.1	1.8	-1.3	-1.8	-2.1	-0.4
3.0	2013 GEN (ex-spec)		104.49	0	99	3.33	17.2	23.9	6.7	13.3	16.0	2.7	72.5	58.8	-13.7	4.0	3.1	-0.9	-1.4	-1.9	-0.5
3.0	2012 GEN (ex-spec)		104.49	0	105	3.39	16.3	22.9	6.6	13.0	15.7	2.7	74.1	60.6	-13.5	4.0	3.1	-0.9	-1.3	-1.9	-0.6
3.5	2019 GEN (ex-spec)		105.05	0	24	4.00	33.1	48.6	15.5	26.3	35.7	9.4	63.0	19.6	-43.3	2.2	1.1	-1.1	-1.4	-1.1	0.3
3.5	2017 GEN (ex-spec)		105.05	0	48	3.90	28.2	41.0	12.8	21.7	29.6	7.9	78.3	42.6	-35.7	2.6	1.3	-1.3	-1.5	-1.6	-0.1
3.5	2016 GEN (ex-spec)		105.05	0	61	3.88	25.7	36.8	11.0	19.2	25.6	6.4	88.5	59.5	-29.1	3.0	1.9	-1.2	-1.3	-1.6	-0.3
3.5	2015 GEN (ex-spec)		105.05	0	72	3.88	23.4	34.0	10.5	17.7	24.0	6.3	94.0	65.5	-28.5	3.2	2.0	-1.2	-1.4	-1.7	-0.3
3.5	2013 GEN (ex-spec)		105.05	0	97	3.85	18.0	24.7	6.7	13.4	16.9	3.5	112.3	94.3	-18.0	4.0	3.0	-1.0	-1.1	-1.6	-0.6
4.0	2019 GEN (ex-spec)		105.91	0	27	4.49	33.5	46.4	13.0	28.2	35.1	6.9	82.8	43.0	-39.8	2.1	1.3	-0.8	-0.8	-0.7	0.1
4.0	2018 GEN (ex-spec)		105.91	0	37	4.47	30.5	44.0	13.5	25.5	33.6	8.1	93.5	46.3	-47.2	2.3	1.1	-1.2	-1.0	-1.0	0.1
4.0	2017 GEN (ex-spec)		105.91	0	49	4.39	29.1	41.1	12.0	23.8	30.9	7.1	100.9	62.3	-38.6	2.5	1.4	-1.1	-0.9	-1.1	-0.2
4.0	2014 GEN (ex-spec)		105.91	0	85	4.35	20.6	28.5	7.9	16.6	21.5	4.9	132.9	108.4	-24.6	3.5	2.5	-1.0	-0.8	-1.2	-0.3
4.0	2010 GEN (ex-spec)		105.91	0	129	4.39	17.9	24.8	6.8	14.1	18.0	4.0	140.0	116.5	-23.5	3.5	2.4	-1.1	-1.1	-1.8	-0.7
4.5	2019 GEN (ex-spec)		106.63	0	30	4.96	34.4	46.0	11.6	29.7	35.1	5.5	101.4	65.6	-35.8	2.1	1.5	-0.6	-0.4	-0.4	0.0
4.5	2018 GEN (ex-spec)		106.63	0	36	4.94	33.5	47.1	13.7	28.8	36.9	8.1	105.7	49.0	-56.7	2.1	1.0	-1.1	-0.5	-0.6	-0.1
4.5	2011 GEN (ex-spec)		106.63	0	122	4.82	15.7	22.3	6.6	13.1	17.3	4.2	181.0	155.9	-25.1	3.8	2.7	-1.1	-0.8	-1.4	-0.6
4.5	2010 GEN (ex-spec)		106.63	0	133	4.87	16.9	24.6	7.7	14.1	19.0	5.0	174.6	144.9	-29.7	3.4	2.2	-1.2	-1.0	-1.5	-0.5
5.0	2018 GEN (ex-spec)		107.43	0	37	5.49	35.6	48.5	12.9	30.4	38.0	7.6	115.7	56.9	-58.7	2.1	1.3	-0.8	-0.1	-0.2	0.0

- Changes in the GNMA sector were generally similar to conventional. Media effect changes in the model were substantially the same, and changes to the ramp and the FHA S-curve had somewhat analogous effects to PIW changes and S-curve adjustments made for conventional.
- The updated HPA forecast (from 3% to 17% for 2021) is especially significant for GNMs, given its impact on turnover, cashouts, and FHA-to-conventional refinancing.
- For premium coupons, OASs and durations tend to be higher than conventional in v21.7. The lower credit profile and buyouts make GNMA prepayments less rate sensitive, but absolute buyout projections are uncertain.

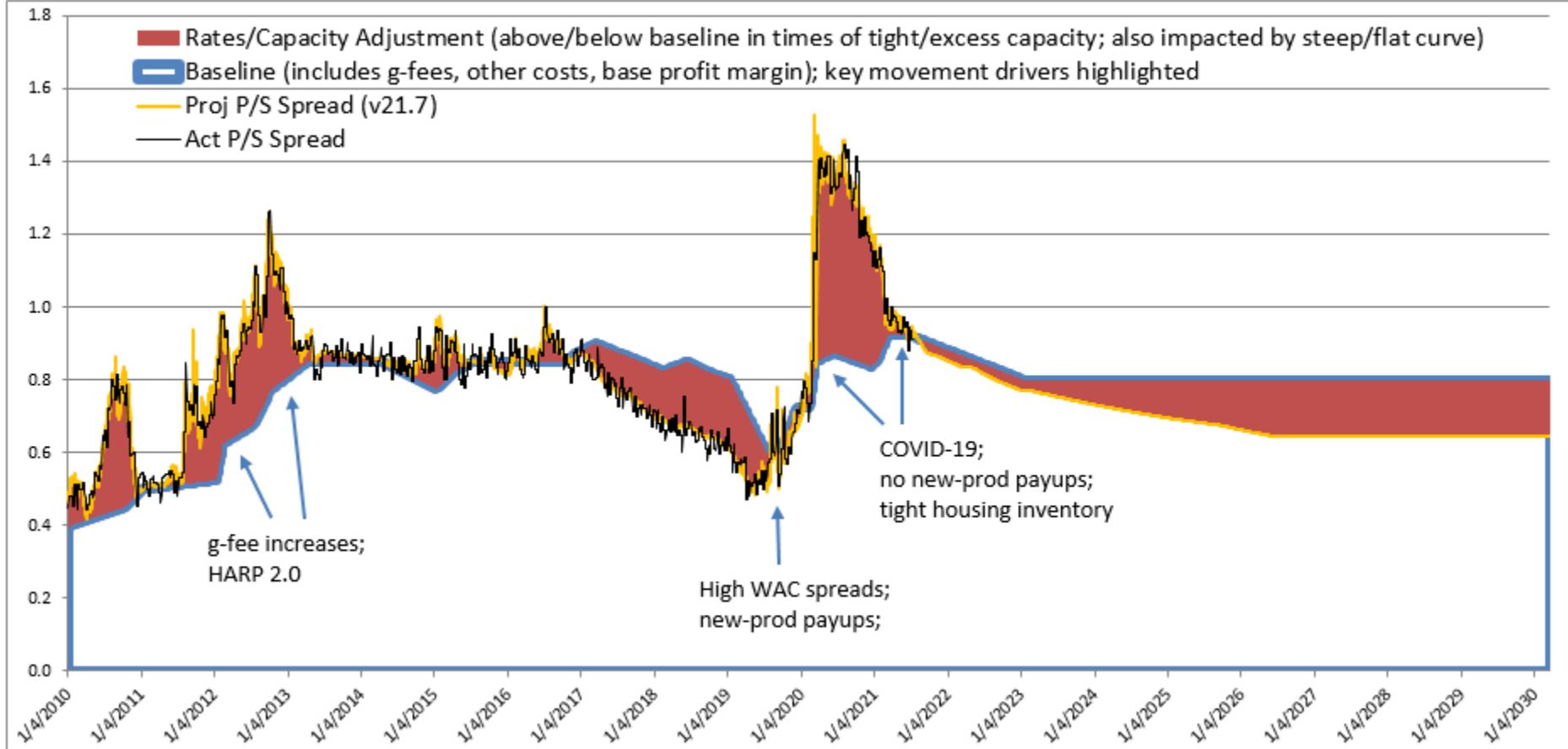
Derivative Benchmark Bond Comparisons: v21.7 vs. v21.6

	Curve Date: 7/28/2021				1 Yr Proj CPR			LT Proj CPR			OAS			Eff Duration			Eff Convexity		
Deal	Level	Age	WAC	Old	New	Diff	Old	New	Diff	Old	New	Diff	Old	New	Diff	Old	New	Diff	
GNMA10.26(QS)	17.32	138	4.89	17.1	24.9	7.8	14.4	19.3	4.9	947	350	-597	4.9	-4.3	-9.2	-16.9	-21.7	-4.8	
GNMA10.20(SE)	17.40	138	5.30	16.7	24.4	7.7	14.6	19.7	5.1	946	350	-596	6.9	-1.3	-8.2	-15.1	-18.3	-3.2	
FHL.PC.311(S1)	15.86	97	3.96	20.1	28.8	8.7	16.7	21.2	4.5	917	350	-567	-6.6	-18.0	-11.3	-26.0	-34.5	-8.6	
FHL.PC.326(S2)	16.42	104	4.42	19.1	27.8	8.7	15.9	19.4	3.5	952	450	-502	3.0	-2.9	-6.0	-17.2	-21.7	-4.5	
FHLMC4611(BS)	18.43	166	6.07	17.0	20.8	3.7	15.2	17.6	2.5	422	150	-272	11.2	9.9	-1.4	-12.5	-11.6	0.9	
FNMA13.121(SA)	18.11	193	5.98	15.8	19.7	3.9	14.3	16.8	2.4	417	150	-267	11.3	9.6	-1.8	-12.5	-12.4	0.1	
FNMA16.19(SA)	17.36	219	5.98	14.6	18.9	4.4	13.1	15.8	2.7	413	100	-313	11.4	9.2	-2.2	-13.2	-14.1	-0.9	
FNMA16.32(SA)	17.18	222	5.96	14.3	18.6	4.3	12.9	15.6	2.7	407	100	-307	11.3	9.1	-2.2	-13.4	-14.4	-1.1	
FNMA16.7(SH)	17.23	227	6.56	14.6	18.5	3.9	13.2	15.7	2.5	334	50	-284	11.8	9.9	-1.9	-13.0	-13.8	-0.8	
FHLMC4400(SA)	20.24	164	7.05	15.7	18.1	2.4	14.1	15.8	1.7	269	100	-169	13.4	12.8	-0.6	-12.2	-11.5	0.6	
FNMA15.19(SA)	17.38	230	6.99	14.4	17.7	3.3	13.1	15.2	2.1	285	50	-235	12.2	10.7	-1.4	-12.8	-13.3	-0.5	
FNMA15.66(AS)	18.94	232	7.08	11.8	13.4	1.7	11.4	12.3	0.9	142	50	-92	13.7	13.6	-0.1	-11.4	-11.3	0.1	
GNMA10.9(UI)	17.13	139	5.31	16.4	23.5	7.1	14.3	19.0	4.7	859	400	-459	-6.6	-15.1	-8.5	-2.0	-3.3	-1.3	
FHLMC4585(AS)	18.13	170	6.11	19.2	22.3	3.1	15.7	18.1	2.3	406	150	-256	11.5	10.1	-1.4	-12.6	-11.7	0.9	
FHLMC4937(MS)	17.27	31	5.01	21.0	28.2	7.2	17.7	21.2	3.4	769	350	-419	1.4	-4.2	-5.6	-18.4	-19.5	-1.1	
FNMA20.37(IM)	14.95	62	4.45	19.4	25.4	6.0	16.1	18.8	2.7	640	350	-290	-15.5	-21.2	-5.8	-6.0	-8.9	-2.9	
FNMA18.39(SA)	13.80	53	4.96	28.2	37.6	9.4	23.4	29.2	5.7	1117	350	-767	-3.0	-14.2	-11.3	-16.6	-23.9	-7.3	
FNMA18.44(SA)	13.80	53	4.96	28.2	37.6	9.4	23.4	29.2	5.7	1117	350	-767	-3.0	-14.2	-11.3	-16.6	-23.9	-7.3	
FHL.PC.377(C1)	9.85	10	2.95	10.6	25.1	14.5	12.7	19.1	6.5	297	-100	-397	-44.0	-68.6	-24.6	-37.9	-23.6	14.2	
FHL.PC.375(C1)	9.03	12	3.41	26.5	43.0	16.5	19.3	29.6	10.3	553	-50	-603	-55.2	-81.3	-26.1	-14.0	15.0	28.9	
GNMA21.9(MI)	12.14	7	2.93	12.4	18.3	5.9	13.5	16.4	3.0	357	150	-207	-18.7	-22.4	-3.7	-8.6	-8.4	0.3	
GNMA19.137(PI)	10.49	22	3.97	22.0	33.3	11.3	17.7	23.3	5.6	1147	650	-497	-12.7	-20.0	-7.3	-2.5	1.1	3.6	
GNMA19.158(PI)	10.42	21	3.96	22.3	33.7	11.5	17.9	23.6	5.7	1150	650	-500	-12.8	-20.5	-7.7	-2.6	1.2	3.8	
FHLMC4981(MI)	16.29	32	5.54	23.8	30.8	7.0	20.7	24.6	3.9	714	350	-364	-14.7	-19.4	-4.8	-1.2	-3.1	-1.9	
FHLMC4980(KI)	13.79	28	5.18	24.4	33.9	9.5	21.0	26.7	5.7	885	350	-535	-18.1	-26.6	-8.5	-3.3	-0.2	3.1	
FNMA19.25(SA)	20.51	36	5.55	18.8	22.4	3.6	15.2	16.6	1.4	457	300	-157	7.8	6.2	-1.6	-14.3	-15.2	-0.8	

- Unsurprisingly, most derivative bonds run at significantly lower OASs in model version 21.7 as compared to version 21.6, given their sensitivity to prepayments. As noted in the four preceding slides and in the subsequent model performance discussion, prepayment projections generally increase significantly across the board. Both the conventional and GNMA universes are paying right in line historically with the new model v21.7, but have paying at almost 170% of version 21.6 over the past three months.

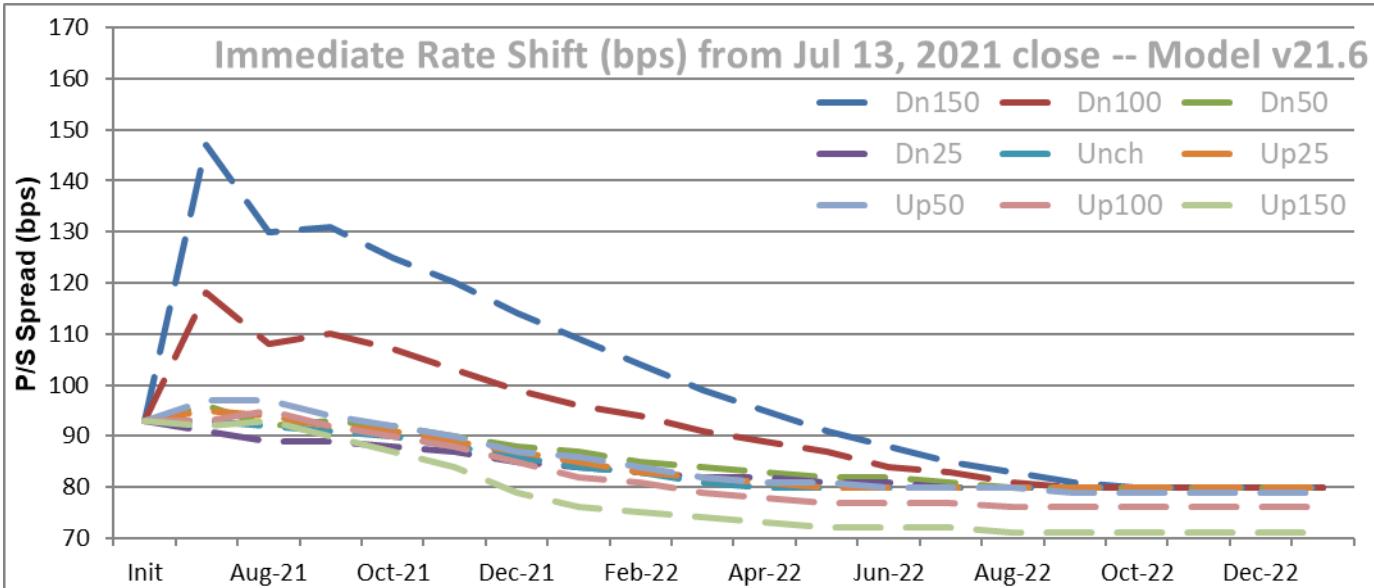
KEY MORTGAGE RATE SUBMODEL CHANGES FOR V21.6

P/S Spread Modeled to Normalize Gradually As Fed Exits



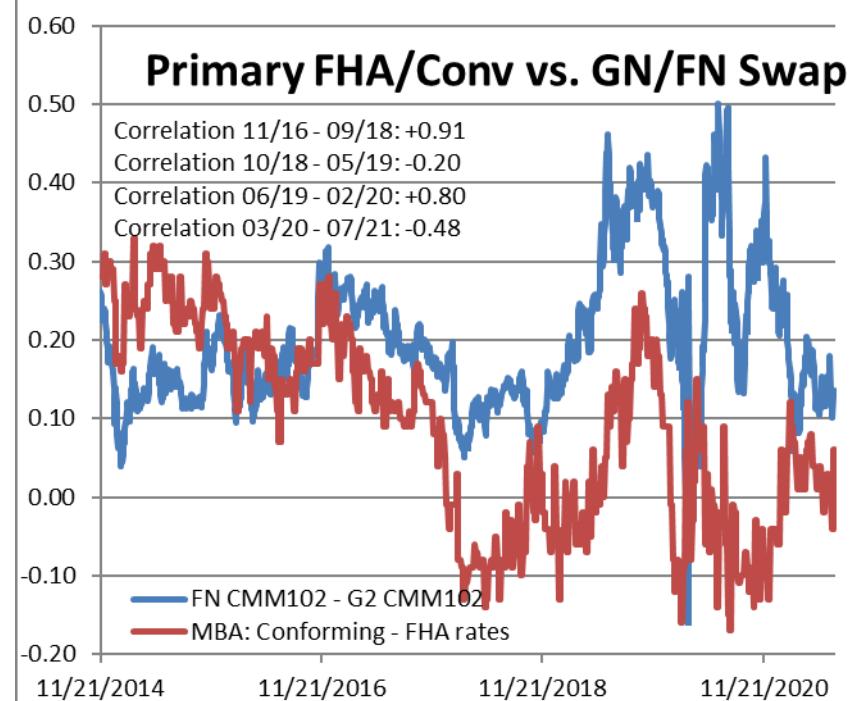
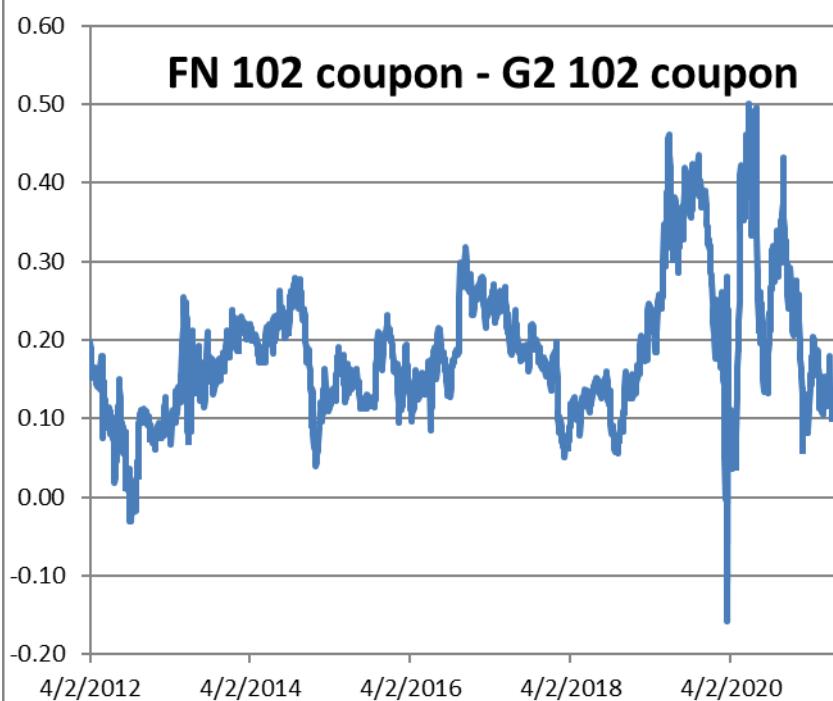
- Model v21.6 P/S spread (before automatic error correction) has been 5-10 bps below actual levels recently; it has not fallen as much as expected. Possible explanations are lack of new prod pay-ups that may be passed through to borrowers, and a strong purchase market in which borrowers are less likely to shop for the lowest mortgage rate.
- Model v21.7 P/S spread assumes that baseline levels normalize by the end of 2022 when Fed participation in the TBA market and other COVID-driven factors are no longer significant. We assume a long-term baseline of 80 bps, about 5 bps below the post-crisis average, from modest technology-driven efficiency gains beyond what has already occurred. Actual levels are likely to be lower at constant rates, because of a flat curve and a diminishing refinanciable universe.

P/S Spread Again More Sensitive to Capacity/Rates in v21.7



- Model v21.6 P/S spread shows negligible widening in a 50 bps rally that would make substantially all 2s and 2.5s refinancible, and only 25 bps in a 100 bps rally that would make the entire universe refinancible.
- We believe the industry would face more significant capacity challenges in this environment than implied by v21.6 P/S spread movements. Model version 21.7 envisions a more substantial widening in most rally scenarios, and a slower decline to baseline when the rally is especially strong.
- In the long run on the rising forward path however, we expect the spread could narrow to around 55 bps. The tight spread would be driven by the flat curve, the significant decline in the refinancible universe over time, and ongoing efficiency gains.

GN/FN Swap and Primary Rates Uncorrelated During COVID



- The GNMA primary rate is especially important for new WALA GNMs refinance into another FHA/VA/RHS loan. Model version 21.4 introduced the GNMA/FNMA swap as a driver for relative primary rates for FHA/VA and conventional loans, as seemed reasonable and supported by historical correlation at that time.
- However, two significant periods of non-correlation have occurred recently, once during the period of high WAC spreads leading up to UMBS single security, and the other during the current COVID-19 crisis.
- As a result, in model version 21.6 we temporarily replaced the GNMA/FNMA swap (FN CMM102 – G2 CMM102) with a constant of 1/8 point, as the spread to subtract from conventional rates to obtain the FHA rate.
- At present, we are still uncertain of the best way to incorporate a relationship that should and does generally exist, but can break down during turbulent periods. We have elected to set the conventional-to-FHA primary rate spread to the average of 1/8 point and the GN/FN swap in model version 21.7, but will continue to consider alternatives.

Other Actual/Prospective Rate-Related Adjustments in v21.7

- **Termination of Adverse Market Refinance Fee.** This was modeled as a refinancing cost (LLPA) impact rather than a change to overall levels of mortgage rates. However, its likely effect was about a 1/8 increase in mortgage rates for refinances. We believe most lenders removed the fee as soon as practicable after the FHFA announced its termination on July 16, 2021. We believe closing times are still quite spread out across originators, with some lenders taking three weeks and others taking up to three months. Thus we model the impact of termination at 50% in August and fully effective in September.
- **TCCA Expiration.** In December 2011, Congress enacted the Temporary Payroll Tax Cut Continuation Act of 2011 which required the GSEs and GNMA guarantors charging annual MIPs (FHA, RH) to implement a 10 bps increase in their annual guarantee fees in 2012. This expires at the end of the 2021 federal fiscal year (Sep 30), but FHFA has directed the GSEs to maintain it through year-end 2021. The White House 2022 budget proposal did not mention the fee, but there are substantial budget increases for housing and other programs (and the Senate has already included it in a bipartisan infrastructure bill). Thus model version 21.7 tentatively leaves TCCA in place. The following links discuss TCCA in more detail: <https://www.nar.realtor/washington-report/presidents-fy-2022-budget-and-tax-proposals>; <https://www.housingwire.com/articles/reducing-the-racial-wealth-gap-by-expanding-down-payment-assistance/>; <https://www.urban.org/urban-wire/fhfa-has-small-window-enact-policy-create-more-equitable-housing-finance-system>.
- **GNMA Guarantor MIP Changes.** The Obama Administration's 25 bps FHA MIP reduction in January 2017 (later suspended by the Trump Administration and never reinstated) and possible TCCA expiration raise the possibility of medium-term MIP reductions at FHA and RH. FHA MMIF reserves, when next reported in November, should be above the already historically high 6.1% FY 2020 levels, following very strong HPA that has occurred despite the COVID crisis. Model v21.7 does not assume any such MIP reductions, but provisions have been made to enable rapid implementation if required (either via a production model update or experimental model release).
- **15-Year and 5x1 Mortgage Rates.** Future differences of shorter-term mortgage rates vs. 30yr rates are modeled in v21.6 and previous models as a weighted average of current point-adjusted differences (as reported by FHLMC PMMS), and differences that result from a linear-least-squares fit of historical PMMS 30yr to 15yr point-adjusted mortgage rate spreads versus 10yr to 5yr swap spreads. The weight on the latter increases over the forward projection period. No structural changes are made to this methodology for model version 21.7, but CMT spreads are used instead of swap spreads because of industry-wide LIBOR replacement initiatives.

IMPROVED MODEL PERFORMANCE OF V21.7 VERSUS V21.6

Model v21.7 in Line with 3 and 12 Month Actuals In-Sample

Asset Class	Balance(mm)	Last Hist Date	2106		2107							
			3M Hist CPR	12M Hist CPR	3M Proj CPR	3M Ratio	12M Proj CPR	12M Ratio	3M Proj CPR	3M Ratio	12M Proj CPR	12M Ratio
FN30	2457594	202106	23.9	30.9	14.1	1.69	24.9	1.24	23.8	1.00	30.7	1.00
FN30HHLB	108132	202106	22.2	25.0	13.7	1.62	21.0	1.19	22.5	0.99	25.7	0.97
FN30HLB	117955	202106	22.2	23.4	14.5	1.54	20.2	1.16	22.6	0.98	24.5	0.96
FN30LLB	43606	202106	18.2	17.2	13.2	1.38	15.4	1.11	17.6	1.03	17.7	0.97
FN30MLB	65177	202106	20.4	20.2	13.9	1.46	17.7	1.15	20.3	1.00	21.0	0.96
FN30MAX200K	100398	202106	20.6	25.1	12.6	1.64	21.0	1.20	20.8	0.99	25.6	0.98
FN30JUMBO	74375	202106	27.4	42.6	14.3	1.92	34.0	1.25	26.9	1.02	41.9	1.02
FN30INV	59058	202106	20.1	24.3	10.5	1.90	18.3	1.33	18.8	1.07	25.1	0.97
FN30CQ	15249	202106	32.1	29.3	18.9	1.70	23.8	1.23	30.0	1.07	30.6	0.96
FN30CR	13656	202106	32.3	29.0	18.9	1.72	23.4	1.24	30.7	1.05	29.0	1.00
FN30NY	62032	202106	15.8	19.4	9.8	1.61	18.4	1.06	15.7	1.00	20.1	0.96
FN30FICO	135624	202106	27.9	29.5	18.5	1.50	27.0	1.09	26.5	1.05	30.2	0.98
FH30	1134567	202106	31.4	36.2	18.7	1.68	29.4	1.23	31.8	0.99	36.6	0.99
GNI130	1746646	202106	31.4	34.4	18.7	1.68	27.4	1.26	32.4	0.97	33.0	1.04
GNIIMAX200K	26065	202106	25.8	24.7	14.5	1.78	20.3	1.21	25.2	1.03	23.2	1.06
GNI130HHLB	37444	202106	29.4	27.4	16.2	1.81	23.1	1.19	28.9	1.02	27.1	1.01
GNI130HLB	63604	202106	29.3	26.2	16.2	1.80	22.4	1.17	28.9	1.01	27.0	0.97
GNI130MLB	27429	202106	26.2	22.7	14.6	1.79	19.3	1.18	25.3	1.04	23.2	0.98
GNI130LLB	16668	202106	22.7	19.0	12.9	1.75	16.5	1.15	22.0	1.03	19.9	0.95
GNIIJUMBO	46828	202106	36.3	47.2	19.8	1.83	35.7	1.32	36.0	1.01	44.0	1.07
GNIIRH	26814	202106	15.1	15.3	9.3	1.62	14.6	1.05	16.5	0.91	16.9	0.91
GNIINY	4447	202106	27.5	25.2	13.3	2.06	24.0	1.05	29.7	0.93	27.5	0.92
GN30	74366	202106	27.0	27.3	16.0	1.69	21.8	1.26	26.4	1.02	28.1	0.97
FN15	461580	202106	18.6	22.2	14.8	1.25	19.4	1.14	19.4	0.95	21.4	1.04
FH15	350567	202106	17.8	21.1	14.3	1.24	18.8	1.12	18.7	0.95	20.6	1.02
GNI15	23283	202106	26.5	28.6	18.7	1.42	23.5	1.22	28.0	0.95	29.4	0.97
GN15	2677	202106	20.0	20.3	15.8	1.27	18.1	1.12	20.0	1.00	21.1	0.96
FN20	157489	202106	20.7	27.0	13.9	1.49	22.1	1.22	21.5	0.96	27.4	0.99
FH20	117971	202106	18.4	24.8	12.8	1.44	20.8	1.19	19.7	0.93	25.7	0.97
FN10	24441	202106	17.8	21.2	15.2	1.17	19.8	1.07	18.7	0.95	21.1	1.01
FH10	8270	202106	15.1	19.5	13.0	1.16	17.7	1.10	15.9	0.95	19.1	1.02
FN5X1L	7204	202106	31.7	33.7	21.3	1.49	28.3	1.19	29.4	1.08	33.6	1.00
FN7X1L	10154	202106	40.5	41.8	27.3	1.48	36.2	1.15	37.5	1.08	42.5	0.98
FNTX1L	4290	202106	40.9	41.5	26.3	1.56	35.3	1.18	38.4	1.06	41.9	0.99
FH5X1L	4358	202106	33.9	35.6	22.9	1.48	30.4	1.17	32.0	1.06	36.8	0.97
FH7X1L	8327	202106	43.1	44.0	28.4	1.52	37.3	1.18	40.0	1.08	45.3	0.97
FHTX1L	4093	202106	39.5	41.1	26.4	1.50	35.3	1.17	39.4	1.00	42.8	0.96
GN3X1T	3710	202106	29.3	32.2	23.9	1.22	31.2	1.03	29.0	1.01	31.0	1.04
GN5X1T	4584	202106	39.1	39.4	24.6	1.59	33.7	1.17	36.8	1.06	39.2	1.00

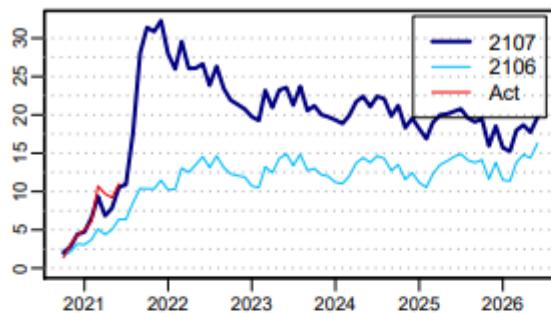
Model version 21.6 has generally projected slower speeds than actuals since it was released. Speeds have recently been printing 170% of v21.6, which underestimated the magnitude and persistence of the refinancing response to the COVID-driven rally.

In contrast, model version 21.7 actual to projected ratios are very close to 1.0 over the past three and twelve months for most sectors.

The most important drivers of the model changes are a strengthened media effect, a broader impact of GSE and originator efforts to streamline the refinancing process (i.e., extending to more seasoned cohorts), updated HPA assumptions that drive stronger cash-outs and turnover, and the impact of AMRF removal and the RefiNow/RefiPossible programs.

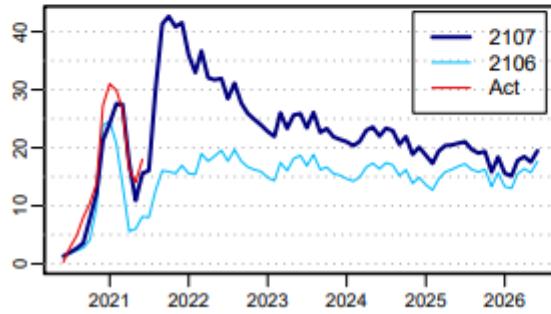
Cuspy New Majors/MLGs Respond to Rally/AMRF Removal

2.00/2020-Q4 WAC 2.91 FSD8106 GRP-0.1 28.9B
LSZ 398 CLTV 59 FICO 770 SATO -25 REFI 73



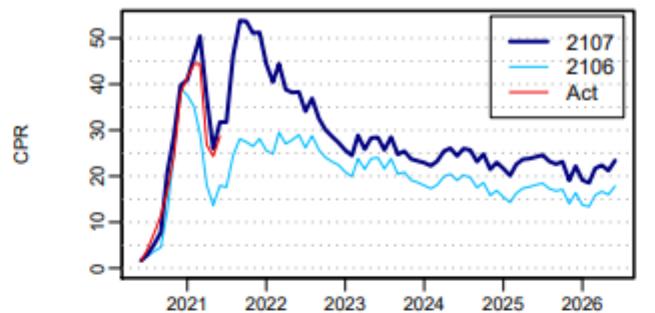
BRO 18 COR 30 RET 52 INV 0 2ND 4 HARP 0 DTI 33 MB 55
PMI 19/ 4 HR 0 PT 62/ 7/ 31 CA 26 CO 6 WA 6 AZ 4 IL 4

2.00/2020-Q3 WAC 3.02 NMA4077 GRP-0.1 13.1B
LSZ 382 CLTV 56 FICO 771 SATO -47 REFI 78



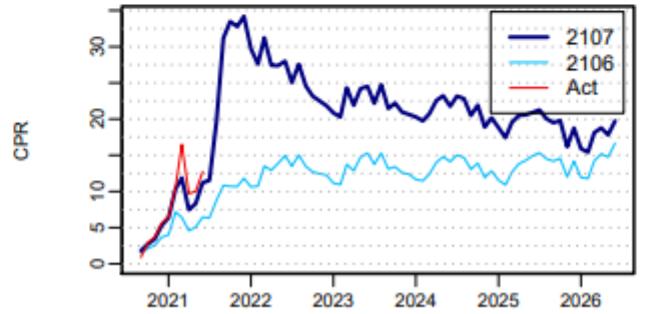
BRO 29 COR 19 RET 52 INV 0 2ND 3 HARP 0 DTI 32 MB 54
PMI 19/ 5 HR 0 PT 62/ 6/ 31 CA 28 CO 6 WA 5 UT 4 AZ 3

2.50/2020-Q3 WAC 3.37 FSD8089 GRP-0.1 16.2B
LSZ 388 CLTV 59 FICO 761 SATO -16 REFI 79



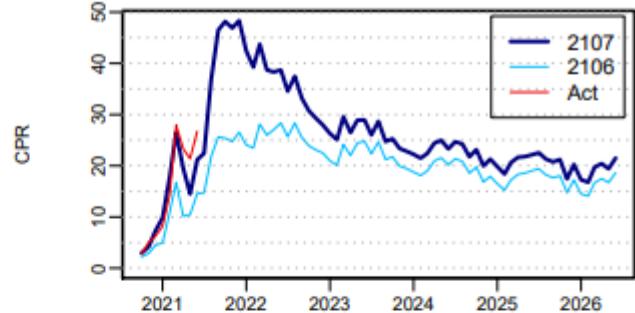
BRO 12 COR 18 RET 70 INV 1 2ND 3 HARP 0 DTI 34 MB 54
PMI 23/ 6 HR 0 PT 63/ 6/ 31 CA 21 WA 6 CO 5 TX 5 AZ 4

2.00/2020-Q4 WAC 2.91 NMA4158 GRP-0.1 27.6B
LSZ 402 CLTV 58 FICO 771 SATO -31 REFI 69



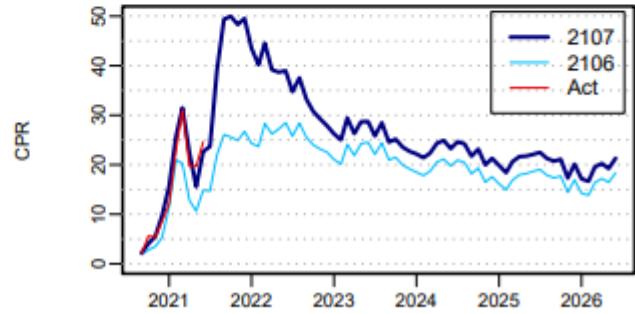
BRO 26 COR 16 RET 58 INV 0 2ND 4 HARP 0 DTI 33 MB 53
PMI 18/ 5 HR 0 PT 61/ 8/ 31 CA 31 CO 6 WA 6 AZ 4 VA 4

2.50/2020-Q4 WAC 3.35 FSD8107 GRP-0.1 4.1B
LSZ 382 CLTV 62 FICO 753 SATO 18 REFI 80



BRO 15 COR 22 RET 63 INV 0 2ND 4 HARP 0 DTI 34 MB 54
PMI 18/ 4 HR 0 PT 64/ 8/ 28 CA 23 WA 6 CO 5 MA 5 AZ 4

2.50/2020-Q4 WAC 3.31 NMA4159 GRP-0.1 10.0B
LSZ 393 CLTV 61 FICO 757 SATO 6 REFI 73

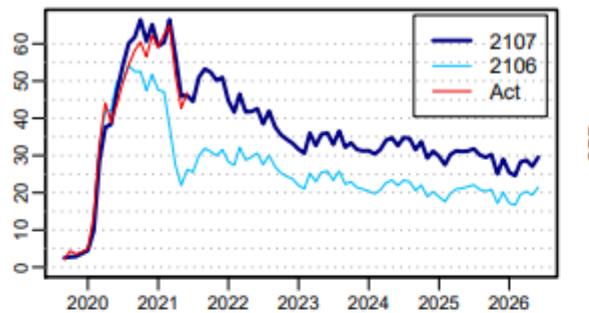


BRO 19 COR 12 RET 69 INV 1 2ND 5 HARP 0 DTI 35 MB 53
PMI 19/ 5 HR 0 PT 62/ 9/ 29 CA 27 CO 7 WA 7 AZ 4 MA 4

- Model v21.7 better matches the initial response of new major/multi pools to the rally earlier in the year, and expects a reasonably strong response to AMRF removal and the renewed rally.
- Longer term speeds are also assumed higher in the base case, resulting from ongoing benefits of a generally less onerous refinancing process and cash-out refinances supported by strong HPA.

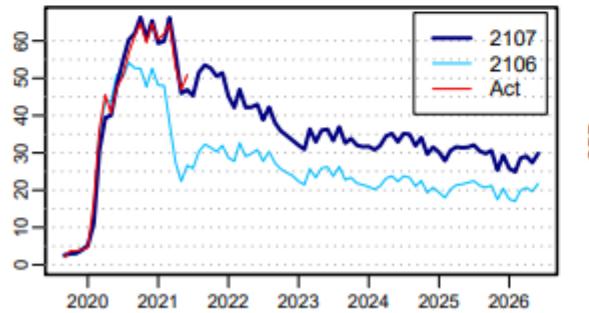
PIW-Driven and Media Effect Ramps Further Extended

3.00/2019-Q4 WAC 3.92 FSD8016 GRP-0.1 4.1B
LSZ 378 CLTV 59 FICO 754 SATO -1 REFI 43



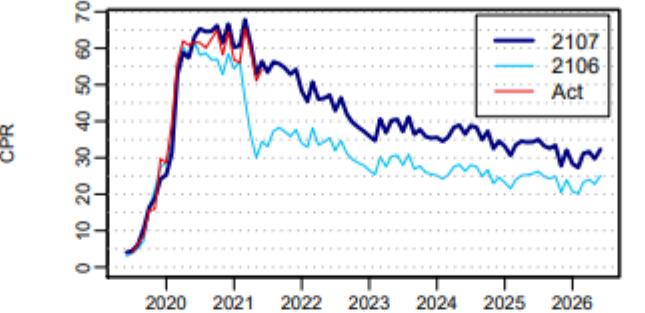
BRO 18 COR 25 RET 57 INV 1 2ND 5 HARP 0 DTI 36 MB 53
PMI 31/ 8 HR 0 PT 60/ 8/ 32 CA 18 FL 7 TX 7 WA 6 CO 5

3.00/2019-Q4 WAC 3.94 NMA3802 GRP-0.1 4.0B
LSZ 377 CLTV 58 FICO 756 SATO 2 REFI 48



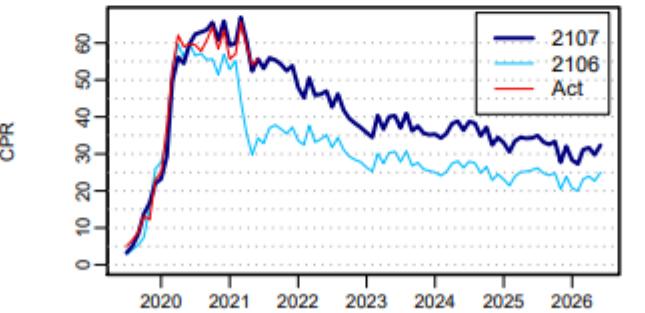
BRO 16 COR 31 RET 54 INV 2 2ND 5 HARP 0 DTI 36 MB 51
PMI 28/ 7 HR 0 PT 58/ 9/ 33 CA 21 CO 6 FL 5 WA 5 MA 4

3.50/2019-Q3 WAC 4.39 FSD8005 GRP-0.1 1.9B
LSZ 371 CLTV 59 FICO 743 SATO 15 REFI 35



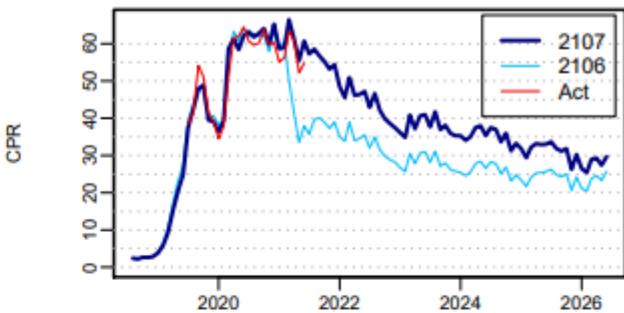
BRO 23 COR 33 RET 44 INV 3 2ND 7 HARP 0 DTI 37 MB 49
PMI 31/ 8 HR 0 PT 60/ 9/ 31 CA 21 FL 8 TX 8 CO 4 NJ 4

3.50/2019-Q3 WAC 4.40 NMA3745 GRP-0.1 2.4B
LSZ 368 CLTV 59 FICO 741 SATO 17 REFI 36



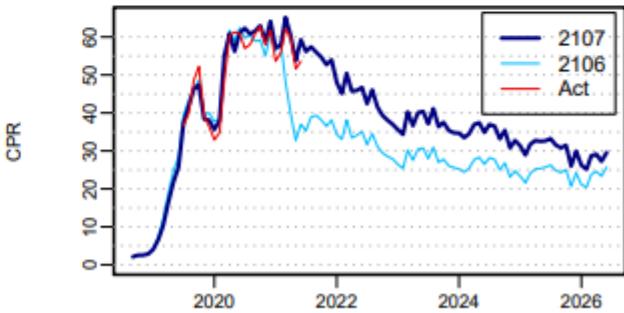
BRO 14 COR 34 RET 52 INV 3 2ND 6 HARP 0 DTI 38 MB 50
PMI 32/ 9 HR 0 PT 56/ 9/ 34 CA 20 FL 9 TX 8 CO 5 WA 5

4.00/2018-Q3 WAC 4.73 FG08842 GRP-0.1 1.5B
LSZ 351 CLTV 57 FICO 745 SATO 8 REFI 21



BRO 17 COR 28 RET 55 INV 2 2ND 5 HARP 0 DTI 38 MB 48
PMI 39/ 11 HR 0 PT 59/ 7/ 33 CA 16 TX 9 FL 8 WA 5 GA 4

4.00/2018-Q4 WAC 4.77 NMA3495 GRP-0.1 2.2B
LSZ 344 CLTV 57 FICO 741 SATO 12 REFI 26

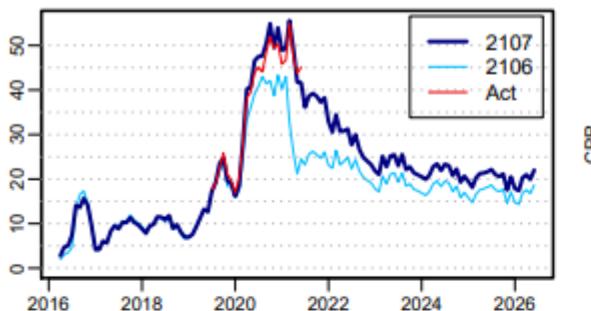


BRO 11 COR 35 RET 54 INV 1 2ND 6 HARP 0 DTI 39 MB 49
PMI 37/ 11 HR 0 PT 56/ 9/ 35 CA 17 FL 9 TX 8 VA 5 CO 4

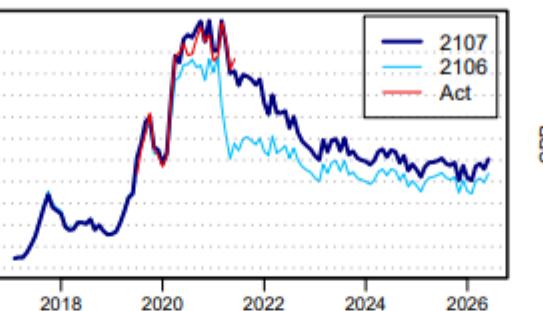
- Model version 21.7 builds in a lower drop-off from peak speeds when rates backed up in Q1 2021. A sustained (and partially COVID-driven) media effect and continued use of PIW and other automated underwriting features continue to support speeds well after initial peak on large major/MLG pools.
- The long-term baseline speed is higher than projected previously. The model has modestly weaker burnout overall, and there is significant build-up of cumulative HPA in the base case.

PIW and Media Effect Also Stronger on 2013-2017 Collateral

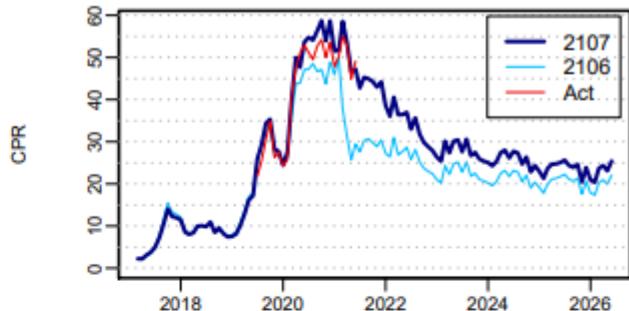
3.50/2016-Q2 WAC 4.17 NBM2001 GRP-0.1 1.8B
LSZ 322 CLTV 44 FICO 741 SATO 24 REFI 50



4.00/2017-Q1 WAC 4.53 NBM2002 GRP-0.1 915MM
LSZ 333 CLTV 47 FICO 736 SATO 29 REFI 43



4.00/2017-Q2 WAC 4.50 NBM2003 GRP-0.1 898MM
LSZ 338 CLTV 48 FICO 724 SATO 26 REFI 41



BRO 13 COR 30 RET 58 INV 12 2ND 4 HARP 0 DTI 36 MB 50
PMI 2/ 6 HR 0 PT 60/ 10/ 29 CA 25 TX 8 FL 7 CO 4 NJ 4

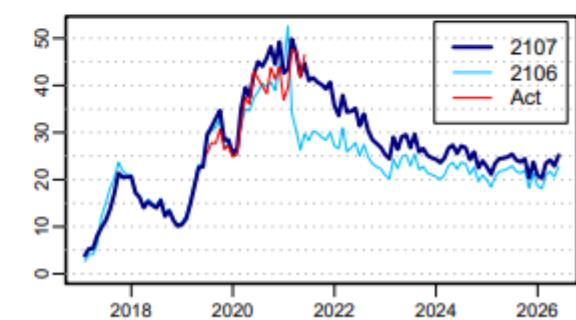
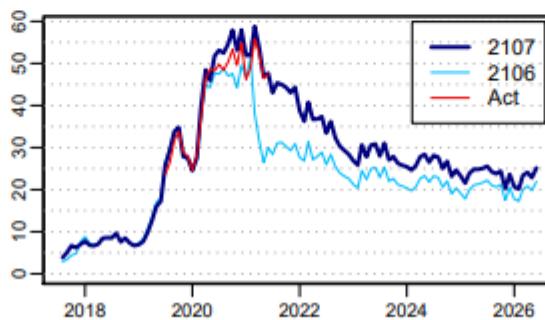
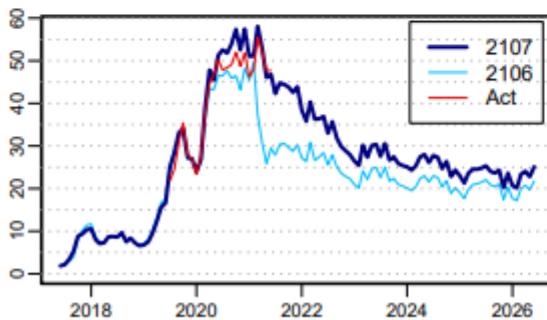
BRO 12 COR 30 RET 58 INV 13 2ND 6 HARP 0 DTI 36 MB 50
PMI 6/ 6 HR 0 PT 60/ 10/ 29 CA 26 FL 9 TX 9 WA 5 CO 4

BRO 12 COR 31 RET 57 INV 8 2ND 6 HARP 0 DTI 37 MB 52
PMI 5/ 6 HR 0 PT 59/ 10/ 31 CA 24 FL 9 TX 9 WA 5 CO 4

4.00/2017-Q3 WAC 4.48 NBM2005 GRP-0.1 1.4B
LSZ 333 CLTV 48 FICO 728 SATO 35 REFI 45

4.00/2017-Q3 WAC 4.47 NBM2006 GRP-0.1 1.0B
LSZ 330 CLTV 50 FICO 726 SATO 36 REFI 47

4.50/2017-Q1 WAC 4.94 NBM2004 GRP-0.1 1.9B
LSZ 326 CLTV 49 FICO 698 SATO 82 REFI 51



BRO 13 COR 31 RET 56 INV 19 2ND 5 HARP 0 DTI 37 MB 49
PMI 9/ 6 HR 0 PT 61/ 10/ 29 CA 26 FL 8 TX 8 CO 4 NJ 4

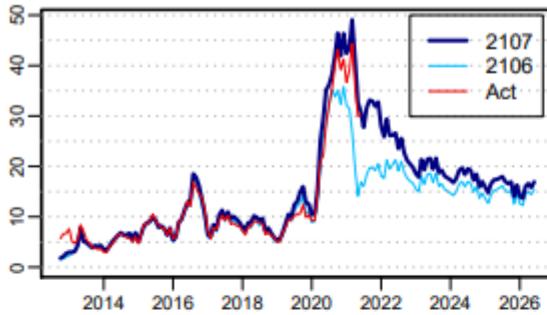
BRO 11 COR 30 RET 59 INV 14 2ND 5 HARP 0 DTI 37 MB 49
PMI 11/ 6 HR 0 PT 60/ 9/ 30 CA 25 FL 9 TX 8 CO 4 NJ 4

BRO 12 COR 36 RET 52 INV 33 2ND 2 HARP 0 DTI 38 MB 49
PMI 10/ 5 HR 0 PT 65/ 8/ 26 CA 28 TX 10 FL 9 AZ 4 CO 4

- Post-HARP collateral from 2013-2017, represented above by the BM series of 2017 FNMA megapools, had a somewhat tepid (on a relative basis) response in some cases early in the crisis, but this type of collateral has prepaid very strong in 2021.
- The initial response was likely hampered by crisis-driven capacity constraints and risk aversion, but this has eased, and we expect speeds to remain strong in a base-case environment.

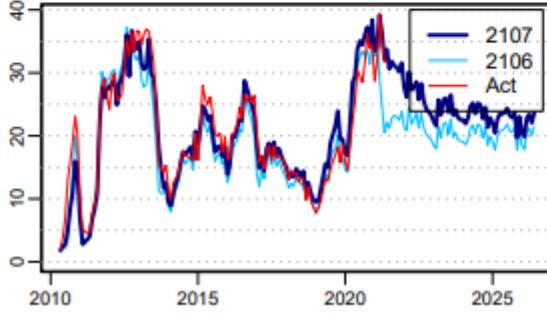
Seasoned Post-HARP Much More Responsive in v21.7

3.0/2012-Q3 FN30DLV WAC 3.58/ -17 LSZ 322 139.6B/ 35.1B
 LTV 70/ 70/ 28 FICO 771 REFI 68/ 14 JMB 3 FT 10
 WELLS 24 OTHER 19 JPM 12 NWRES 7 PNC 5 MTRX 5



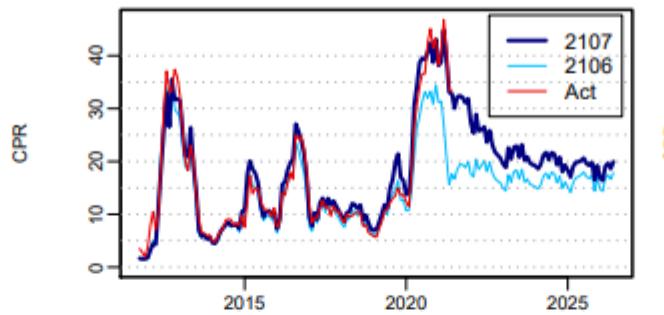
BRO 16 COR 37 RET 47 INV 2 2ND 5 HARP 0 DTI 31
 PMI NA/ NA HR 0 PT NA CA 26 MA 5 TX 5 NJ 4 NY 4

4.5/2010-Q2 FN30DLV WAC 4.93/ -9 LSZ 314 101.6B/ 5.8B
 LTV 72/ 72/ 30 FICO 752 REFI 70/ 21 JMB 2 FT 12
 WELLS 27 BOACW 20 JPM 16 OTHER 11 NWRES 6 NSTAR 4



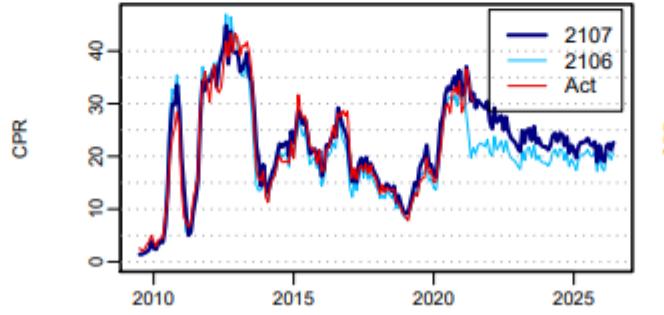
BRO 10 COR 27 RET 63 INV 3 2ND 6 HARP 0 DTI 34
 PMI NA/ NA HR 0 PT NA CA 19 NY 11 NJ 6 TX 5 FL 4

3.5/2011-Q4 FN30DLV WAC 4.01/ -34 LSZ 326 47.5B/ 6.2B
 LTV 68/ 68/ 27 FICO 771 REFI 69/ 16 JMB 3 FT 9
 WELLS 31 OTHER 17 JPM 16 NWRES 10 BOACW 6 MTRX 3



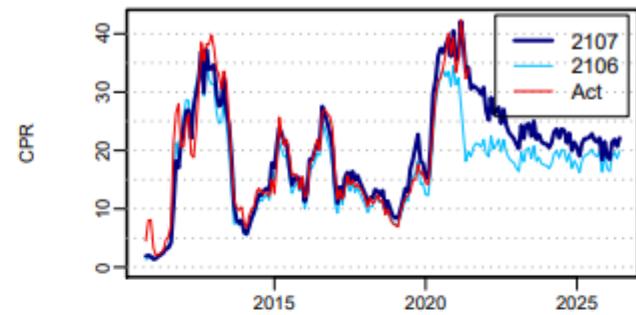
BRO 12 COR 41 RET 47 INV 1 2ND 5 HARP 0 DTI 31
 PMI NA/ NA HR 0 PT NA CA 19 NY 7 NJ 5 TX 5 MA 4

4.5/2009-Q2 FN30DLV WAC 4.93/ -32 LSZ 311 246.2B/ 9.6B
 LTV 70/ 70/ 29 FICO 754 REFI 81/ 30 JMB 2 FT 6
 BOACW 28 WELLS 19 OTHER 14 JPM 11 NWRES 9 TRUIS 4



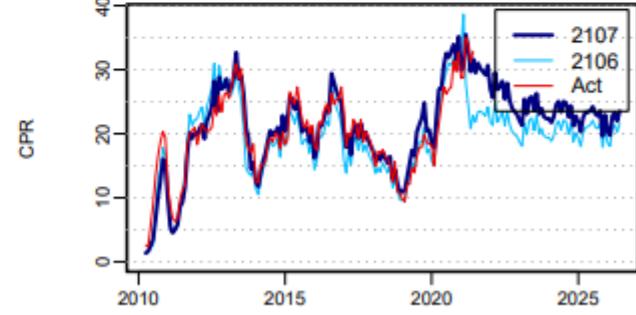
BRO 11 COR 28 RET 61 INV 2 2ND 5 HARP 24 DTI 35
 PMI NA/ NA HR 0 PT NA CA 15 NY 9 NJ 6 WA 5 FL 4

4.0/2010-Q4 FN30DLV WAC 4.49/ -17 LSZ 320 102.2B/ 8.1B
 LTV 69/ 69/ 28 FICO 764 REFI 75/ 23 JMB 3 FT 9
 JPM 21 WELLS 20 OTHER 15 BOACW 13 NWRES 8 PNC 3



BRO 11 COR 35 RET 54 INV 1 2ND 5 HARP 0 DTI 32
 PMI NA/ NA HR 0 PT NA CA 18 NY 8 NJ 6 TX 5 VA 5

5.0/2010-Q2 FN30DLV WAC 5.36/ 24 LSZ 298 42.6B/ 2.7B
 LTV 78/ 78/ 35 FICO 726 REFI 81/ 17 JMB 2 FT 8
 WELLS 28 BOACW 24 JPM 19 OTHER 7 NSTAR 5 NWRES 4

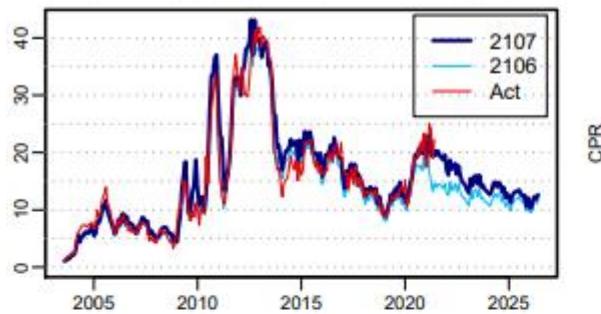


BRO 8 COR 16 RET 76 INV 6 2ND 5 HARP 0 DTI 36
 PMI NA/ NA HR 0 PT NA CA 17 NY 11 NJ 8 IL 6 MD 5

- Post-HARP 2009-2012 cohorts have been vastly more responsive this year than in prior rallies from 2015-2019. While 2009 cohorts had some HARP-eligible loans and thus didn't quite reach prior highs, the 2010-2012 cohorts eclipsed their previous highs reached during the 2012-2013 boom.
- We assume these borrowers are too seasoned / burned out to benefit from PIW and other streamlining initiatives. A borrower-driven media effect enhanced by the unique COVID environment (e.g., record low rates, borrowers working from home, forbearance-related servicer contact) seems the most likely driver.

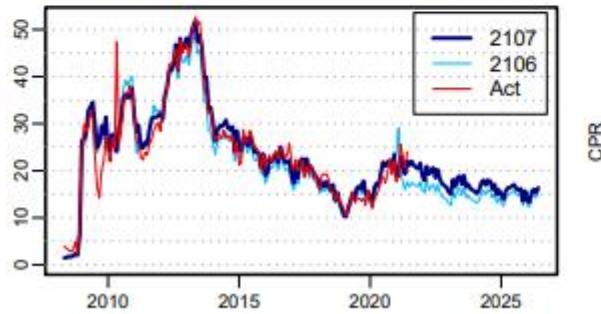
Even Pre-HARP Responds, Long after HARP Expiration

4.5/2003-Q3 FN30GEN WAC 5.06/ -63 LSZ 217 38.5B/ 1.1B
 LTV 68/ 68/ 18 FICO 730 REFI 73/ 28 JMB 0 FT 0
 JPM 28 NWRES 23 BOACW 13 OTHER 12 WELLS 9 NSTAR 6



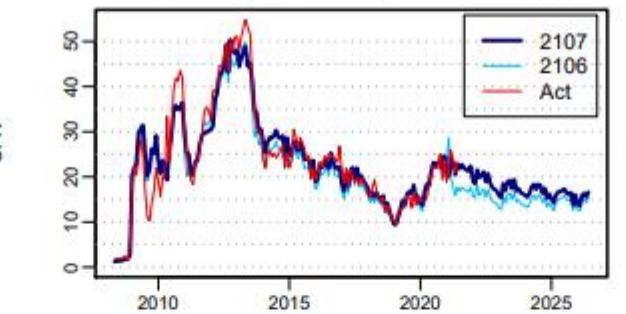
BRO NA COR NA RET NA INV 2 2ND 3 HARP 92 DTI NA
 PMI NA/ NA HR 0 PT NA CA 21 NY 7 FL 6 GA 5 NJ 5

5.5/2008-Q2 FN30GEN WAC 6.04/ -12 LSZ 265 148.4B/ 2.4B
 LTV 72/ 72/ 34 FICO 723 REFI 60/ 38 JMB 0 FT 0
 NWRES 17 WELLS 15 BOACW 15 OTHER 15 NSTAR 13 JPM 9



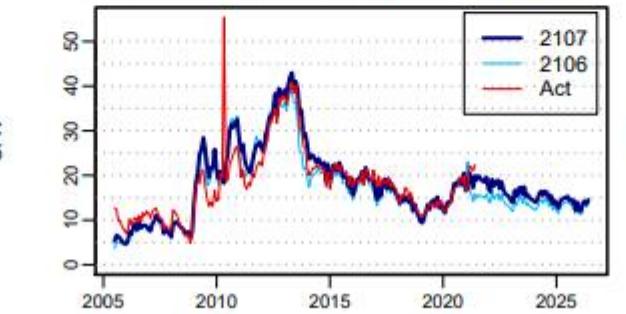
BRO 20 COR 26 RET 54 INV 7 2ND 5 HARP 98 DTI NA
 PMI NA/ NA HR 0 PT NA CA 13 NY 9 FL 8 TX 7 IL 4

5.0/2008-Q2 FN30GEN WAC 5.65/ -43 LSZ 288 89.3B/ 1.5B
 LTV 71/ 71/ 32 FICO 732 REFI 66/ 38 JMB 0 FT 1
 BOACW 20 NWRES 18 OTHER 14 NSTAR 12 WELLS 10 JPM 11



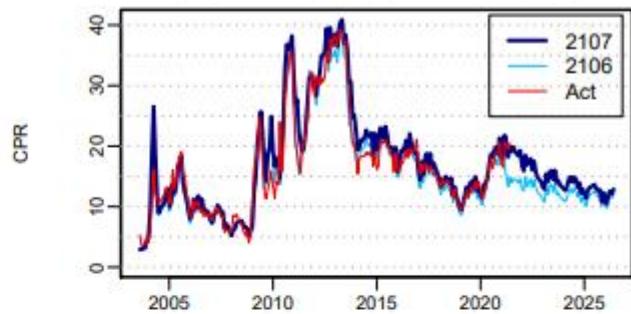
BRO 15 COR 26 RET 58 INV 4 2ND 5 HARP 96 DTI NA
 PMI NA/ NA HR 0 PT NA CA 17 NY 8 FL 6 TX 6 GA 4

5.5/2005-Q3 FN30GEN WAC 5.98/ 6 LSZ 209 131.3B/ 3.2B
 LTV 72/ 72/ 29 FICO 709 REFI 57/ 40 JMB 0 FT 0
 NWRES 23 NSTAR 16 OTHER 15 JPM 12 BOACW 12 WELLS 9



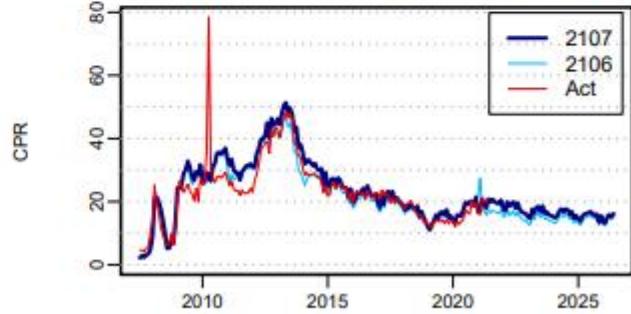
BRO NA COR NA RET NA INV 8 2ND 5 HARP 98 DTI NA
 PMI NA/ NA HR 0 PT NA CA 12 FL 10 NY 9 NJ 5 TX 5

5.0/2003-Q3 FN30GEN WAC 5.50/ -29 LSZ 208 226.2B/ 4.7B
 LTV 70/ 70/ 19 FICO 720 REFI 75/ 31 JMB 0 FT 0
 NWRES 22 JPM 21 BOACW 16 OTHER 12 WELLS 9 NSTAR 8



BRO NA COR NA RET NA INV 3 2ND 3 HARP 98 DTI NA
 PMI NA/ NA HR 0 PT NA CA 18 FL 7 NY 7 IL 4 MA 4

6.0/2007-Q3 FN30GEN WAC 6.57/ 12 LSZ 235 185.8B/ 3.0B
 LTV 74/ 74/ 36 FICO 703 REFI 57/ 39 JMB 0 FT 0
 NWRES 20 NSTAR 18 OTHER 18 WELLS 13 BOACW 9 JPM 8

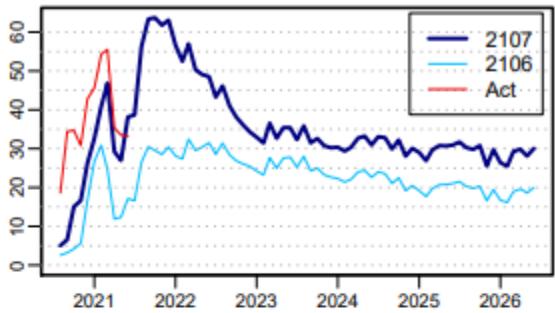


BRO 19 COR 26 RET 55 INV 9 2ND 5 HARP 99 DTI NA
 PMI NA/ NA HR 0 PT NA CA 9 FL 9 TX 9 NY 8 PA 5

- Driven by similar factors as 2009-2012 post-HARP cohorts, pre-HARP collateral has managed a fairly healthy and sustained response so far despite its significant burnout. Some cohorts have matched or even exceeded prepayment levels immediately post-taper-tantrum 7 to 8 years ago, at which time these borrowers remained well in-the-money and eligible for HARP.

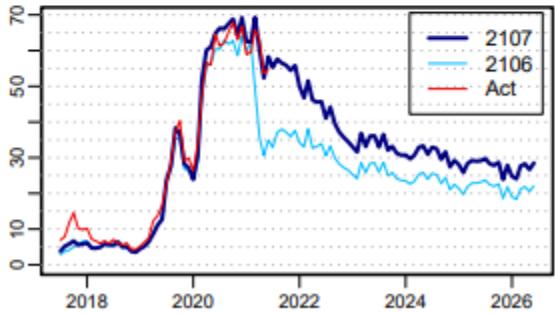
Jumbos Explosive As Usual; Many Are Now Conforming

2.5/2020-Q3 FN30JUMBO WAC 3.33/ -2 LSZ 638 10.6B/ 6.8E
 LTV 72/ 72/ 59 FICO 761 REFI 68/ 12 JMB 86 FT 17
 OTHER 20 JPM 10 QUICK 10 WELLS 8 CLBR 7 PENNY 6



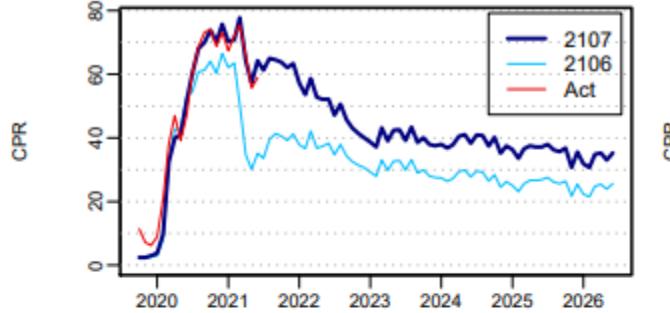
BRO 22 COR 18 RET 59 INV 2 2ND 2 HARP 0 DTI 35
 PMI 21/ 5 HR 0 PT NA CA 56 NY 12 WA 9 VA 5 NJ 4

3.5/2017-Q3 FN30JUMBO WAC 4.16/ 9 LSZ 544 11.3B/ 2.0B
 LTV 74/ 73/ 48 FICO 747 REFI 40/ 15 JMB 46 FT 27
 NWRES 12 JPM 9 QUICK 9 MTRX 7 OTHER 7 CITI 6



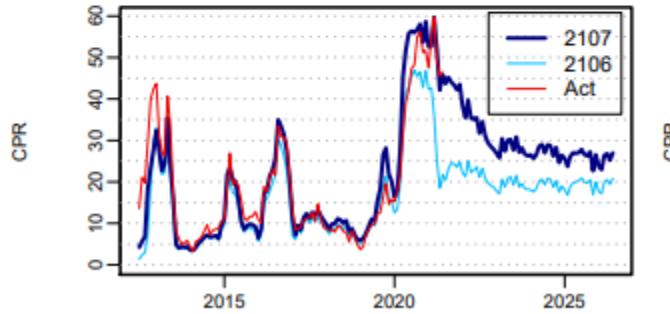
BRO 26 COR 24 RET 51 INV 5 2ND 3 HARP 0 DTI 38
 PMI 18/ 5 HR 0 PT NA CA 48 NY 21 WA 7 NJ 5 VA 5

3.0/2019-Q4 FN30JUMBO WAC 3.87/ 2 LSZ 604 9.7B/ 2.4B
 LTV 76/ 75/ 57 FICO 754 REFI 54/ 10 JMB 72 FT 21
 NWRES 23 CLBR 11 JPM 10 QUICK 8 OTHER 8 LAKEV 7



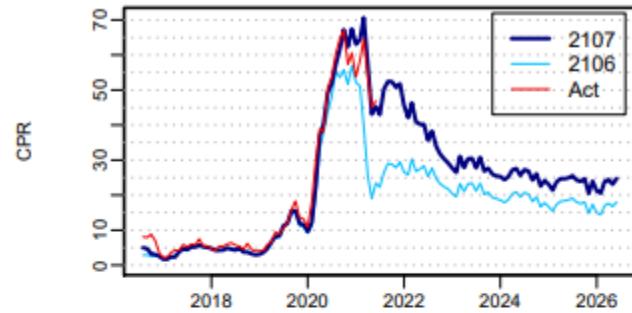
BRO 32 COR 26 RET 41 INV 2 2ND 2 HARP 0 DTI 38
 PMI 30/ 7 HR 0 PT NA CA 55 NY 12 WA 9 NJ 5 VA 5

3.5/2012-Q2 FN30JUMBO WAC 4.02/ 6 LSZ 545 14.6B/ 1.4B
 LTV 68/ 68/ 27 FICO 771 REFI 63/ 2 JMB 47 FT 12
 WELLS 47 NWRES 11 JPM 9 OTHER 5 PNC 4 MTRX 4



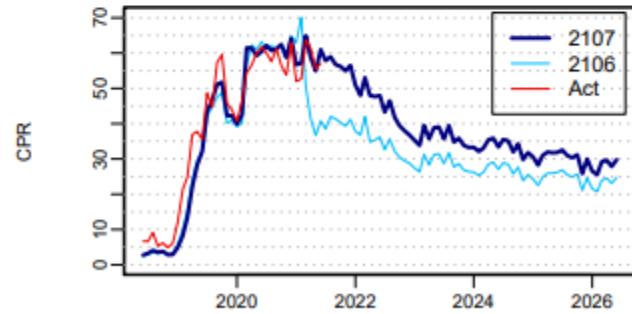
BRO 17 COR 28 RET 55 INV 2 2ND 1 HARP 0 DTI 32
 PMI NA/ NA HR 0 PT NA CA 51 NY 20 NJ 8 VA 8 MD 5

3.0/2016-Q3 FN30JUMBO WAC 3.66/ -4 LSZ 535 15.3B/ 3.8B
 LTV 70/ 70/ 41 FICO 762 REFI 48/ 9 JMB 39 FT 23
 CITI 16 JPM 10 NWRES 10 MTRX 8 LAKEV 6 QUICK 5



BRO 16 COR 24 RET 60 INV 2 2ND 2 HARP 0 DTI 35
 PMI 9/ 2 HR 0 PT NA CA 50 NY 18 NJ 8 WA 7 VA 6

4.0/2018-Q3 FN30JUMBO WAC 4.80/ 30 LSZ 580 5.7B/ 946M
 LTV 76/ 76/ 54 FICO 732 REFI 35/ 22 JMB 60 FT 34
 TRUIS 17 NWRES 15 CLBR 10 QUICK 9 MUFGU 6 MTRX 5

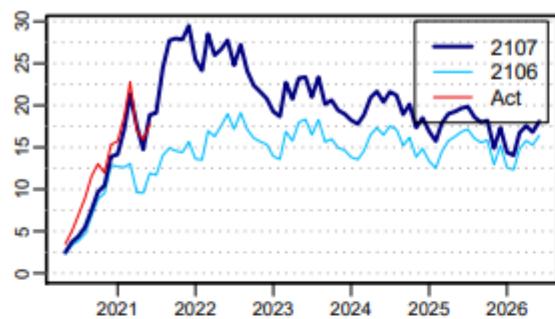


BRO 31 COR 40 RET 30 INV 10 2ND 2 HARP 0 DTI 41
 PMI 31/ 8 HR 0 PT NA CA 44 NY 29 VA 5 WA 5 MD 4

- For the most part, jumbo model changes parallel those made for conforming loans.
- Many seasoned jumbos borrowers pooled when the GSE loan limits were \$417,000 are now eligible for conforming loans; strong HPA has increased the conforming loan limit to \$548,250 as of the start of 2021. This likely eases the refinancing path slightly for such borrowers.

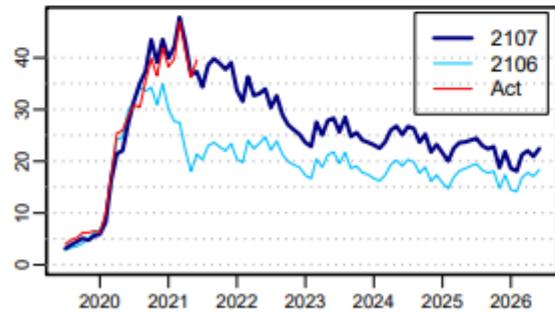
Higher Loan Bal Spec CPRs Now Above TBAs in 2012-2016

3.0/2020-Q2 FN30HHLB WAC 3.72/ 18 LSZ 163 6.7B/ 7.3B
 LTV 76/ 76/ 62 FICO 744 REFI 55/ 25 JMB 0 FT 23
 OTHER 44 WELLS 8 PENNY 6 MTRX 4 QUICK 3 LAKEV 3



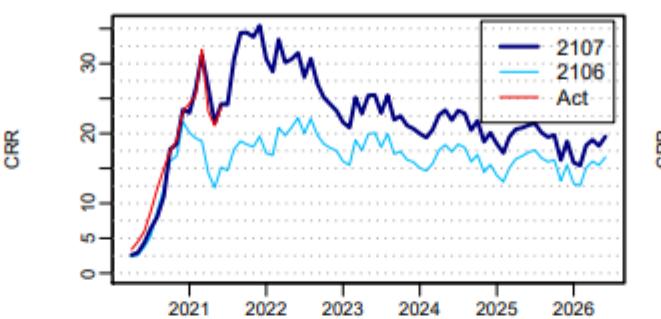
BRO 9 COR 24 RET 68 INV 14 2ND 4 HARP 0 DTI 35
 PMI 32/ 8 HR 0 PT NA TX 10 FL 9 AZ 5 CA 5 MI 5

3.5/2019-Q3 FN30MAX200K WAC 4.35/ 23 LSZ 188 7.4B/ 3.8B
 LTV 81/ 80/ 61 FICO 741 REFI 31/ 20 JMB 0 FT 37
 OTHER 26 WELLS 21 PENNY 11 NWRES 4 JPM 3 MTRX 3



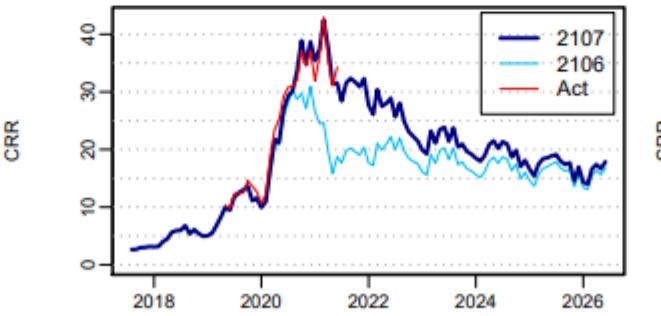
BRO 8 COR 41 RET 51 INV 6 2ND 5 HARP 0 DTI 37
 PMI 43/ 11 HR 0 PT NA TX 11 FL 10 CA 7 AZ 4 GA 4

3.0/2020-Q2 FN30MAX200K WAC 3.83/ 16 LSZ 188 6.9B/ 5.3E
 LTV 77/ 77/ 62 FICO 745 REFI 53/ 25 JMB 0 FT 24
 OTHER 34 WELLS 13 PENNY 8 QUICK 4 LAKEV 4 JPM 3



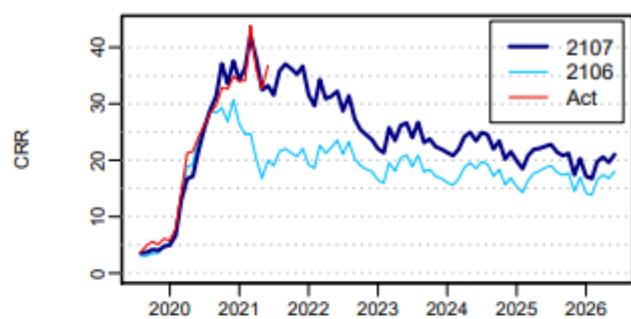
BRO 9 COR 29 RET 63 INV 7 2ND 4 HARP 0 DTI 35
 PMI 33/ 9 HR 0 PT NA TX 10 FL 9 CA 7 AZ 5 GA 4

3.5/2017-Q3 FN30HHLB WAC 4.03/ -4 LSZ 163 7.5B/ 3.4B
 LTV 79/ 78/ 51 FICO 755 REFI 27/ 12 JMB 0 FT 37
 OTHER 28 WELLS 18 JPM 6 MTRX 6 PINGR 5 PENNY 4



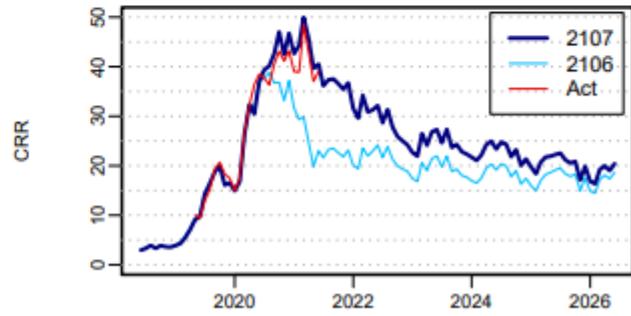
BRO 6 COR 36 RET 58 INV 2 2ND 6 HARP 0 DTI 34
 PMI 38/ 10 HR 0 PT NA TX 8 FL 6 CA 5 MN 5 PA 5

3.5/2019-Q3 FN30HHLB WAC 4.33/ 23 LSZ 163 6.7B/ 3.8B
 LTV 80/ 80/ 61 FICO 742 REFI 31/ 19 JMB 0 FT 39
 OTHER 24 WELLS 21 PENNY 10 QUICK 4 MTRX 4 USHOR 4



BRO 9 COR 36 RET 55 INV 6 2ND 5 HARP 0 DTI 36
 PMI 46/ 12 HR 0 PT NA FL 10 TX 10 CA 5 AZ 4 GA 4

4.0/2018-Q2 FN30HHLB WAC 4.57/ 9 LSZ 163 7.8B/ 3.1B
 LTV 80/ 80/ 56 FICO 744 REFI 28/ 17 JMB 0 FT 40
 OTHER 23 WELLS 20 JPM 6 QUICK 5 MTRX 5 PENNY 4

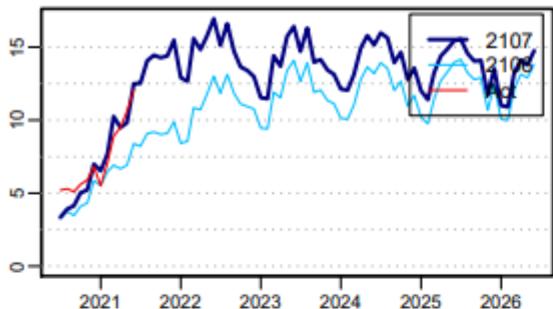


BRO 7 COR 35 RET 59 INV 3 2ND 6 HARP 0 DTI 37
 PMI 44/ 11 HR 0 PT NA FL 9 TX 9 CA 5 GA 5 PA 5

- Speeds on the higher loan balance specs (175k max, 200k max) have been printing in the high 30s and low 40s, slightly above where TBAs typically printed on average in prior rallies (e.g., 3.5s of 2011 in 2012-2013, 4s of 2013 in 2015, 3.5s of 2014 in 2016).
- The RefiNow / RefiPossible programs available to some of these borrowers should provide a modest boost going forward via appraisal cost savings and a looser credit box (up to 65% DTI allowed).

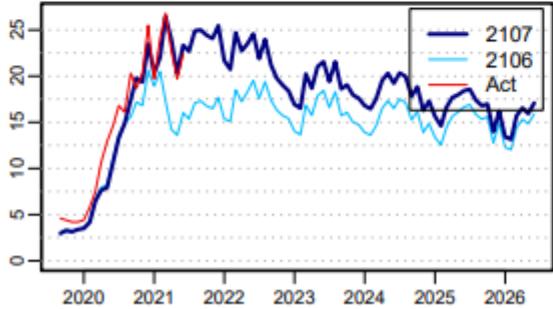
New MLB/LLB Relatively Weaker, But Historically Strong

3.0/2020-Q3 FN30LLB WAC 3.52/ 13 LSZ 71 1.5B/ 1.4B
 LTV 68/ 67/ 56 FICO 747 REFI 42/ 19 JMB 0 FT 25
 OTHER 59 WELLS 6 PNC 2 MTRX 2 LAKEV 2 AMHOM 2



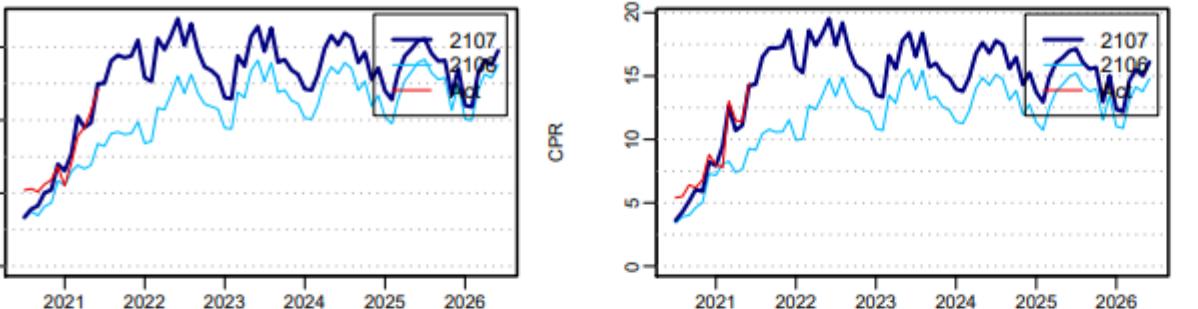
BRO 5 COR 20 RET 75 INV 18 2ND 6 HARP 0 DTI 32
 PMI 25/ 7 HR 0 PT NA MI 8 OH 8 FL 7 IL 6 IN 6

3.5/2019-Q3 FN30MLB WAC 4.08/ 12 LSZ 99 2.0B/ 1.4B
 LTV 71/ 71/ 55 FICO 749 REFI 34/ 19 JMB 0 FT 34
 OTHER 36 WELLS 18 QUICK 6 PENNY 5 JPM 3 MTRX 2



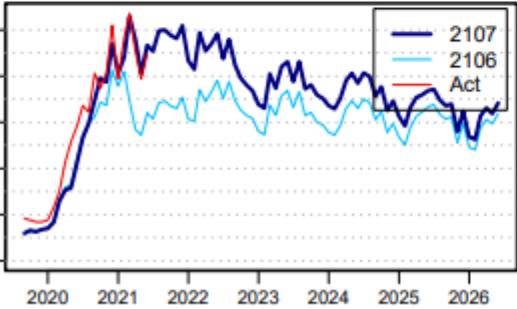
BRO 5 COR 29 RET 65 INV 3 2ND 6 HARP 0 DTI 34
 PMI 31/ 8 HR 0 PT NA FL 8 MI 7 OH 7 IL 6 PA 5

3.0/2020-Q3 FN30MLB WAC 3.55/ 13 LSZ 99 3.6B/ 3.3B
 LTV 69/ 68/ 57 FICO 749 REFI 54/ 24 JMB 0 FT 20
 OTHER 50 WELLS 6 QUICK 6 MTRX 4 JPM 2 PNC 2



BRO 6 COR 19 RET 75 INV 16 2ND 5 HARP 0 DTI 33
 PMI 22/ 6 HR 0 PT NA FL 8 TX 7 MI 6 OH 6 IL 5

4.0/2018-Q2 FN30LLB WAC 4.50/ 13 LSZ 70 1.4B/ 819MM
 LTV 70/ 69/ 48 FICO 741 REFI 33/ 17 JMB 0 FT 35
 OTHER 42 WELLS 11 QUICK 6 JPM 4 MTRX 4 NWRES 4



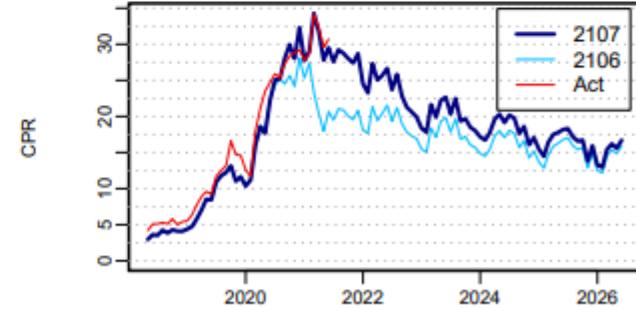
BRO 4 COR 24 RET 71 INV 6 2ND 6 HARP 0 DTI 34
 PMI 32/ 8 HR 0 PT NA OH 10 FL 7 IL 7 MI 7 PA 5

3.5/2019-Q3 FN30LLB WAC 4.03/ 10 LSZ 70 873MM/ 683MM
 LTV 68/ 68/ 52 FICO 748 REFI 30/ 17 JMB 0 FT 35
 OTHER 45 WELLS 14 QUICK 5 PENNY 4 FHLBC 4 JPM 2



BRO 4 COR 28 RET 68 INV 4 2ND 6 HARP 0 DTI 33
 PMI 32/ 8 HR 0 PT NA OH 10 IL 8 MI 8 FL 6 PA 6

4.0/2018-Q2 FN30MLB WAC 4.52/ 11 LSZ 99 2.9B/ 1.5B
 LTV 72/ 71/ 50 FICO 744 REFI 35/ 20 JMB 0 FT 33
 OTHER 30 WELLS 13 QUICK 10 JPM 5 MTRX 5 NWRES 4

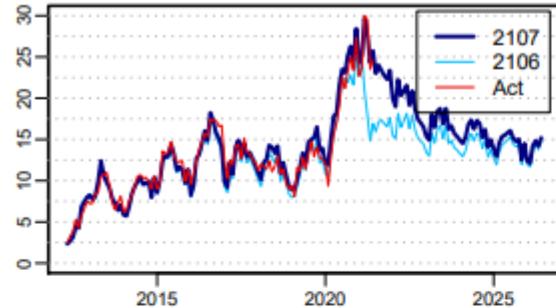


BRO 5 COR 26 RET 69 INV 5 2ND 6 HARP 0 DTI 35
 PMI 30/ 8 HR 0 PT NA FL 9 OH 7 MI 6 TX 6 IL 5

- Call protection is still relatively significant here (speeds generally reaching low-to-mid 20s on LLB and around 30 on MLB vs. 60+ on TBA), but speeds are almost double the rally levels seen from 2012-2016.
- The fixed appraisal cost savings and the higher percentage of these borrowers that are likely <80% AMI makes the RefiNow / RefiPossible impact more significant to LLB/MLB than to higher loan size specs, although the minimum payment reduction of \$50 is tougher to achieve.

Model Slightly Fast On High Premium Seasoned Loan Bal

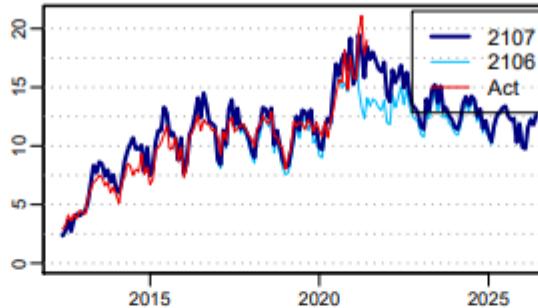
4.0/2012-Q2 FN30HLB WAC 4.47/ 42 LSZ 134 7.5B/ 1.7B
LTV 73/ 73/ 30 FICO 740 REFI 74/ 17 JMB 0 FT 8
WELLS 31 JPM 31 OTHER 8 NWRES 6 PNC 4 BOACW 3



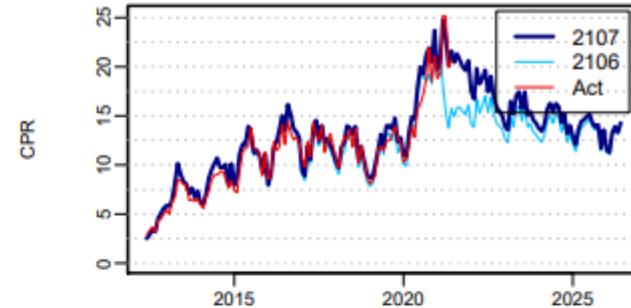
BRO 5 COR 27 RET 68 INV 26 2ND 4 HARP 0 DTI 34
PMI NA/ NA HR 0 PT NA CA 15 TX 8 FL 5 IL 4 NY 4

CPR

4.0/2012-Q2 FN30LLB WAC 4.47/ 51 LSZ 69 4.1B/ 1.2B
LTV 70/ 70/ 29 FICO 742 REFI 69/ 14 JMB 0 FT 8
JPM 31 WELLS 23 OTHER 12 NWRES 9 BOACW 4 PNC 3

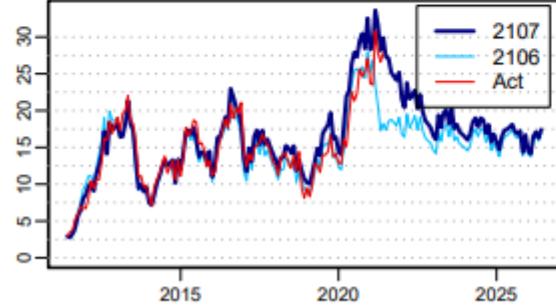


BRO 4 COR 21 RET 75 INV 30 2ND 5 HARP 0 DTI 32
PMI NA/ NA HR 0 PT NA FL 8 CA 7 TX 7 OH 6 MI 5



BRO 5 COR 23 RET 72 INV 30 2ND 4 HARP 0 DTI 33
PMI NA/ NA HR 0 PT NA CA 11 TX 8 FL 6 AZ 4 IL 4

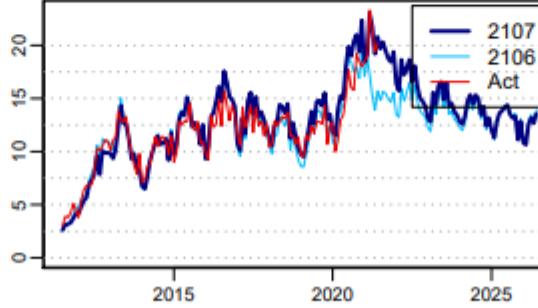
4.5/2011-Q2 FN30HLB WAC 4.93/ 12 LSZ 136 8.7B/ 1.4B
LTV 71/ 71/ 29 FICO 753 REFI 72/ 17 JMB 0 FT 11
JPM 33 WELLS 29 BOACW 10 OTHER 10 NWRES 5 PNC 2



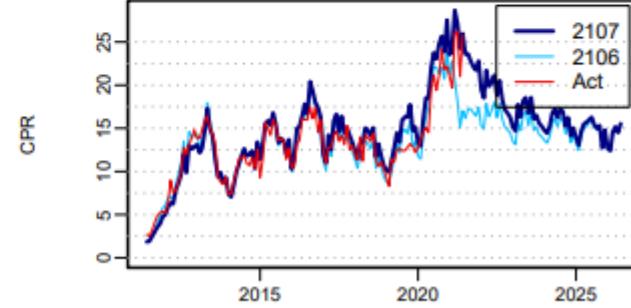
BRO 5 COR 27 RET 69 INV 13 2ND 6 HARP 0 DTI 34
PMI NA/ NA HR 0 PT NA CA 12 TX 7 FL 6 IL 5 NY 5

CPR

4.5/2011-Q2 FN30LLB WAC 4.96/ 22 LSZ 71 3.7B/ 841MM
LTV 67/ 67/ 27 FICO 752 REFI 63/ 18 JMB 0 FT 12
JPM 28 WELLS 19 OTHER 18 BOACW 11 NWRES 5 PNC 2



BRO 4 COR 24 RET 72 INV 20 2ND 6 HARP 0 DTI 32
PMI NA/ NA HR 0 PT NA FL 8 CA 7 TX 7 OH 6 IL 5

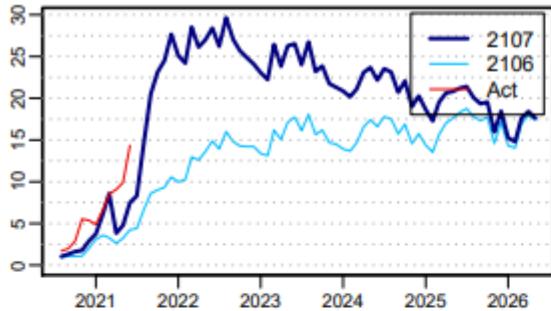


BRO 5 COR 25 RET 70 INV 18 2ND 6 HARP 0 DTI 33
PMI NA/ NA HR 0 PT NA CA 10 TX 8 FL 7 IL 5 PA 5

- While speeds have crept closer to model over recent months, the new model tends to be fast on high premium seasoned loan balance.
- But the model is generally in line on lower coupon seasoned loan balance.

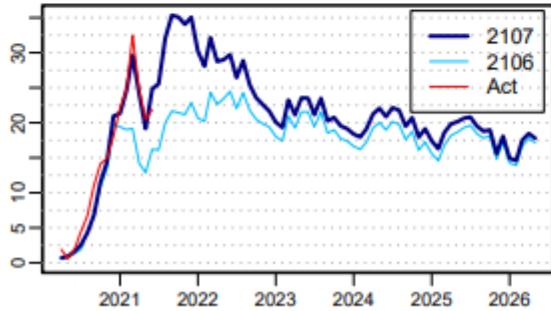
High LTV Prints Very Strong Even Before Reaching 80 LTV

2.5/2020 HFA WAC 3.32/ 1 LSZ 261 1.7B/ 1.7B
LTV 95/ 92/ 80 FICO 743 REFI 15/ 6 JMB 0 FT 76
HFAGY 56 LAKEV 24 USB 20 AMFIN 0 AMHOM 0



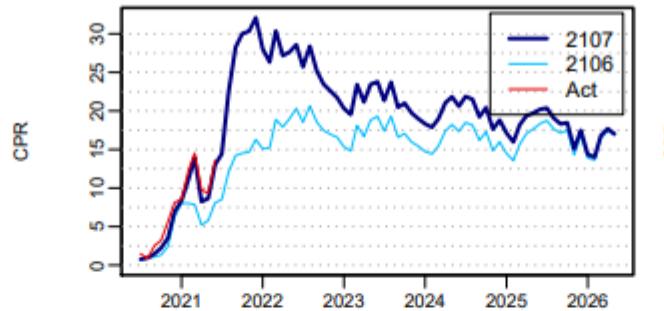
BRO 2 COR 98 RET 1 INV 0 2ND 0 HARP 0 DTI 38 MB 30
PMI 85/ 20 HR 0 PT 59/ 13/ 26 ID 17 CA 15 CO 12 VA 11 IL 7

3.0/2020 HOMEREADY WAC 3.75/ 8 LSZ 228 3.0B/ 3.0B
LTV 96/ 96/ 82 FICO 739 REFI 8/ 0 JMB 0 FT 74
WELLS 23 MTRX 5 USHOR 5 LAKEV 4 PENNY 4



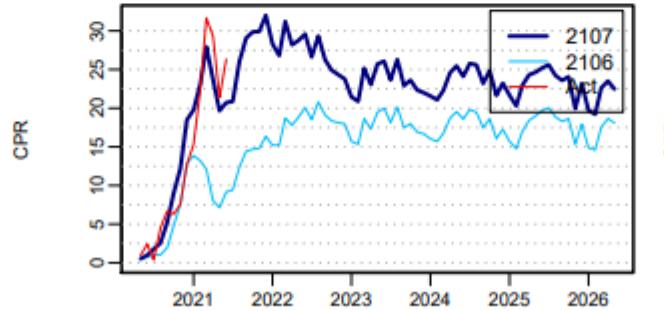
BRO 12 COR 26 RET 62 INV 0 2ND 0 HARP 0 DTI 39 MB 21
PMI 100/ 25 HR 1 PT 63/ 13/ 23 FL 6 TX 6 MD 5 CA 4 GA 4

2.5/2020 HOMEREADY WAC 3.33/ -9 LSZ 242 6.8B/ 6.8B
LTV 96/ 96/ 83 FICO 745 REFI 12/ 0 JMB 0 FT 72
WELLS 14 MTRX 5 USHOR 5 LAKEV 3 MOVEM 3



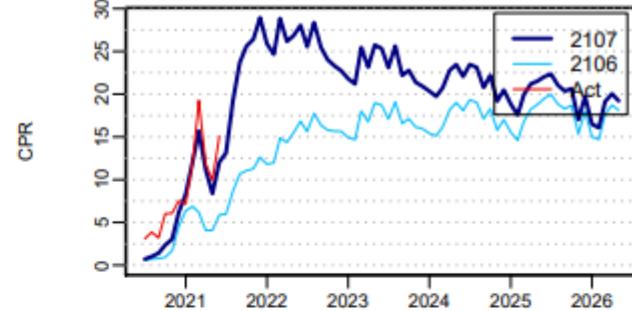
BRO 13 COR 22 RET 65 INV 0 2ND 0 HARP 0 DTI 39 MB 20
PMI 100/ 25 HR 1 PT 62/ 13/ 25 TX 6 FL 5 MD 5 MN 5 VA 5

3.5/2020 HFA WAC 4.27/ 66 LSZ 240 656MM/ 656MM
LTV 100/ 96/ 82 FICO 738 REFI 2/ 1 JMB 0 FT 90
HFAGY 46 USB 31 LAKEV 23 AMFIN 0 AMHOM 0



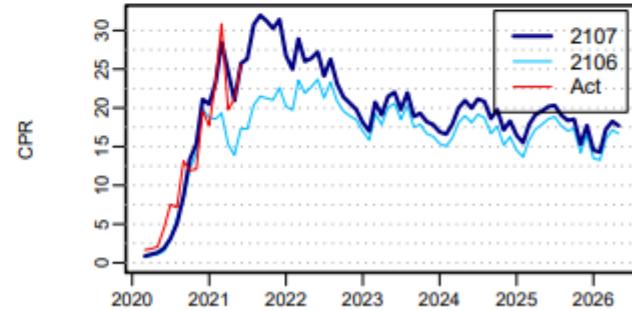
BRO 1 COR 98 RET 0 INV 0 2ND 0 HARP 0 DTI 39 MB 28
PMI 91/ 21 HR 0 PT 61/ 14/ 24 VA 15 AZ 10 MN 10 WA 10 IL 5

3.0/2020 HFA WAC 3.78/ 34 LSZ 245 1.2B/ 1.2B
LTV 99/ 95/ 83 FICO 740 REFI 4/ 2 JMB 0 FT 89
USB 39 HFAGY 37 LAKEV 25 AMFIN 0 AMHOM 0



BRO 0 COR 99 RET 0 INV 0 2ND 0 HARP 0 DTI 38 MB 25
PMI 93/ 21 HR 0 PT 60/ 14/ 25 MN 15 TX 11 VA 10 CA 9 IL 9

3.5/2020 HOMEREADY WAC 4.09/ 36 LSZ 181 491MM/ 491MM
LTV 96/ 96/ 81 FICO 727 REFI 5/ 0 JMB 0 FT 77
WELLS 13 USHOR 10 LAKEV 6 MTRX 5 PENNY 5

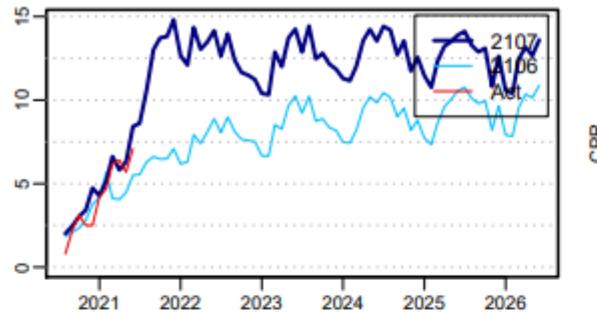


BRO 14 COR 28 RET 57 INV 0 2ND 0 HARP 0 DTI 38 MB 20
PMI 100/ 25 HR 1 PT 67/ 16/ 15 FL 8 MI 6 OH 6 TX 6 IL 5

- Model v21.7 did not have major adjustments targeted to high LTV collateral, but performance improves based on general changes.
- To some extent the high speeds are not surprising, given current HPA levels. But all of these borrowers are now <80% AMI, based on June 2019 change that no longer permitted above that limit in low-income census tracts, so at least some impairment would be expected.

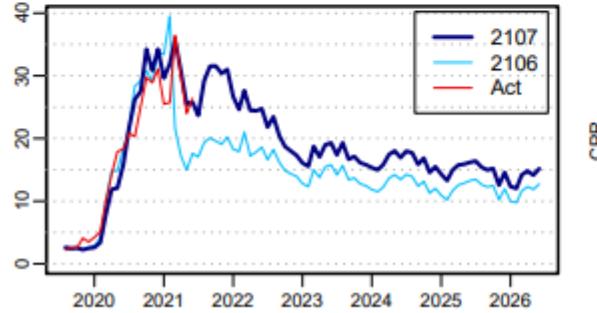
Model Performs Well on NY; Minor Geo Adjustments Overall

2.5/2020-Q3 FN30NY WAC 3.30/ -2 LSZ 403 7.7B/ 7.3B
 LTV 72/ 72/ 61 FICO 753 REFI 63/ 24 JMB 7 FT 21
 OTHER 39 WELLS 7 JPM 7 QUICK 7 CITI 5 HOMPT 4



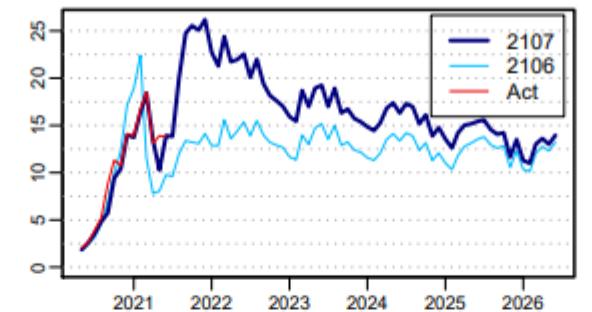
BRO 16 COR 14 RET 71 INV 6 2ND 3 HARP 0 DTI 36
 PMI 23/ 6 HR 0 PT NA NY 100 AL 0 AK 0 AZ 0 AR 0

3.5/2019-Q3 FN30NY WAC 4.15/ 14 LSZ 370 3.6B/ 2.4B
 LTV 76/ 76/ 59 FICO 743 REFI 37/ 24 JMB 4 FT 38
 OTHER 23 WELLS 20 NWRES 9 JPM 8 QUICK 5 HOMPT 4



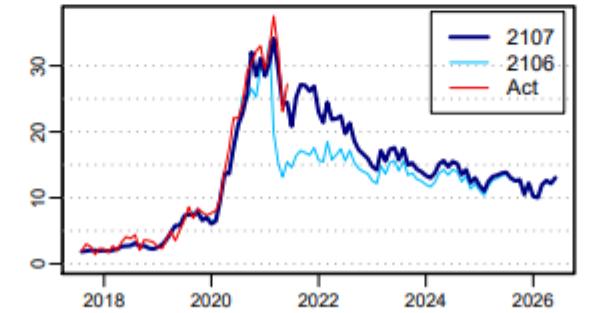
BRO 20 COR 25 RET 55 INV 5 2ND 3 HARP 0 DTI 39
 PMI 32/ 8 HR 0 PT NA NY 100 AL 0 AK 0 AZ 0 AR 0

3.0/2020-Q2 FN30NY WAC 3.70/ 11 LSZ 399 4.2B/ 3.6B
 LTV 73/ 73/ 60 FICO 744 REFI 59/ 32 JMB 6 FT 23
 OTHER 38 JPM 8 WELLS 6 QUICK 5 DEPOT 4 USHOR 4



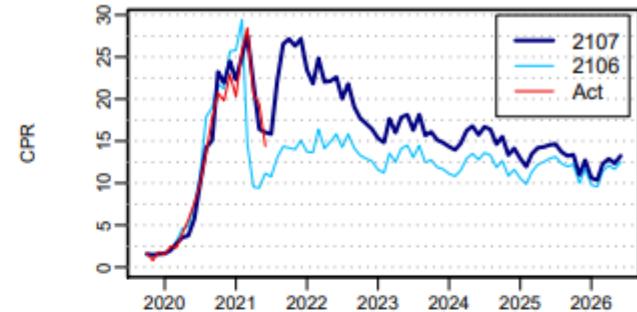
BRO 20 COR 15 RET 65 INV 11 2ND 2 HARP 0 DTI 38
 PMI 23/ 6 HR 0 PT NA NY 100 AL 0 AK 0 AZ 0 AR 0

3.5/2017-Q3 FN30NY WAC 4.01/ -6 LSZ 326 3.9B/ 2.1B
 LTV 74/ 74/ 49 FICO 753 REFI 30/ 16 JMB 2 FT 40
 OTHER 25 WELLS 22 JPM 12 CITI 6 QUICK 5 NWRES 5



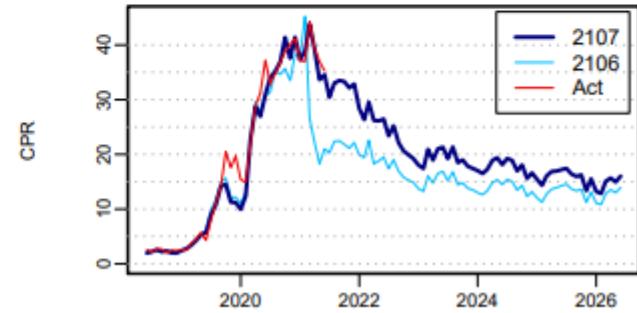
BRO 11 COR 19 RET 70 INV 2 2ND 4 HARP 0 DTI 37
 PMI 24/ 6 HR 0 PT NA NY 100 AL 0 AK 0 AZ 0 AR 0

3.0/2019-Q4 FN30NY WAC 3.72/ -12 LSZ 370 3.5B/ 2.7B
 LTV 75/ 75/ 58 FICO 757 REFI 35/ 16 JMB 4 FT 37
 OTHER 26 WELLS 18 JPM 10 NWRES 8 PENNY 5 CITZN 5



BRO 12 COR 26 RET 61 INV 2 2ND 3 HARP 0 DTI 37
 PMI 30/ 8 HR 0 PT NA NY 100 AL 0 AK 0 AZ 0 AR 0

4.0/2018-Q2 FN30NY WAC 4.54/ 6 LSZ 351 4.2B/ 1.9B
 LTV 74/ 74/ 53 FICO 743 REFI 34/ 24 JMB 4 FT 38
 WELL 22 OTHER 22 JPM 8 QUICK 7 CITI 5 NWRES 5

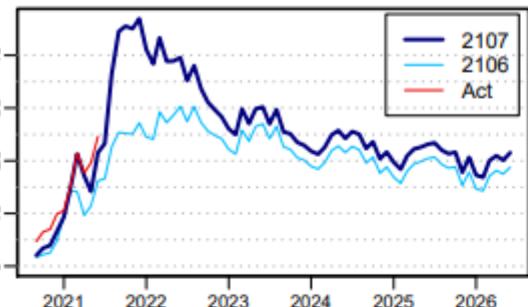


BRO 14 COR 26 RET 60 INV 6 2ND 3 HARP 0 DTI 39
 PMI 26/ 7 HR 0 PT NA NY 100 AL 0 AK 0 AZ 0 AR 0

- Model v21.7 speeds up fully refinancible conventional NY collateral slightly on a relative basis versus cohort, although we also build in slightly higher costs.
- Other geo changes relative to cohort for conventions include slightly faster Florida and slower PR (which was already modeled very slow).

Relative Weaker Initial Ramp for Lower Credit Conventions

2.5/2020-Q3 FN30FICO WAC 3.44/ 18 LSZ 381 17.4B/ 15.1B
LTV 78/ 77/ 64 FICO 676 REFI 58/ 22 JMB 6 FT 19
OTHER 50 QUICK 7 LAKEV 6 MTRX 4 PENNY 3 USB 3



BRO 13 COR 16 RET 71 INV 0 2ND 2 HARP 0 DTI 37
PMI 35/ 9 HR 0 PT NA CA 25 TX 6 WA 6 AZ 5 CO 5

4.0/2019-Q3 FN30FICO WAC 4.88/ 92 LSZ 325 3.1B/ 1.3B
LTV 82/ 82/ 63 FICO 691 REFI 40/ 30 JMB 2 FT 32
PENNY 14 OTHER 12 NWRES 9 QUICK 6 USB 6 WELLS 5



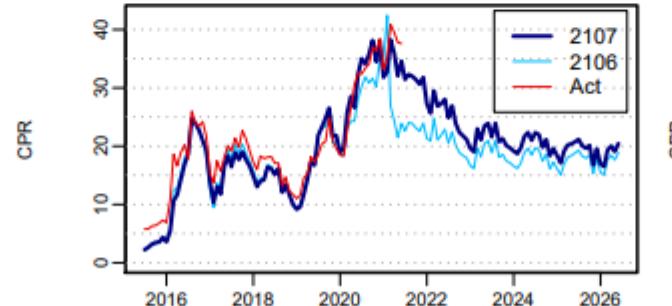
BRO 12 COR 45 RET 43 INV 8 2ND 3 HARP 0 DTI 39
PMI 43/ 12 HR 0 PT NA CA 16 FL 11 TX 10 NY 4 WA 4

3.0/2020-Q2 FN30FICO WAC 3.91/ 45 LSZ 376 6.3B/ 4.6B
LTV 80/ 79/ 65 FICO 674 REFI 54/ 26 JMB 5 FT 22
OTHER 47 LAKEV 10 MTRX 5 QUICK 4 USB 3 PENNY 2



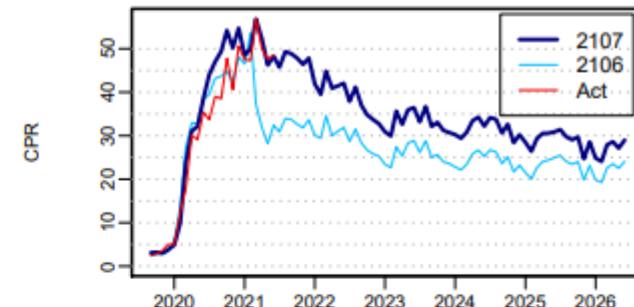
BRO 12 COR 20 RET 67 INV 0 2ND 2 HARP 0 DTI 38
PMI 37/ 10 HR 0 PT NA CA 23 TX 8 WA 6 AZ 4 CO 4

4.0/2015-Q3 FN30FICO WAC 4.65/ 64 LSZ 290 15.7B/ 3.4B
LTV 80/ 79/ 44 FICO 671 REFI 63/ 24 JMB 1 FT 15
NWRES 20 OTHER 15 WELLS 10 JPM 6 QUICK 5 NSTAR 5



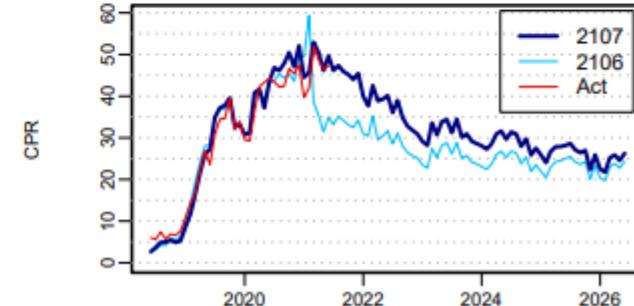
BRO 9 COR 26 RET 65 INV 15 2ND 3 HARP 0 DTI 38
PMI 20/ 5 HR 0 PT NA CA 21 TX 10 FL 7 IL 4 NJ 4

3.5/2019-Q3 FN30FICO WAC 4.40/ 51 LSZ 361 2.3B/ 1.0B
LTV 79/ 78/ 60 FICO 676 REFI 47/ 24 JMB 5 FT 25
OTHER 29 NWRES 7 HFAGY 6 USB 5 PINGR 5 SPCLS 5



BRO 13 COR 27 RET 60 INV 1 2ND 3 HARP 0 DTI 39
PMI 36/ 8 HR 0 PT NA CA 22 TX 8 WA 8 CO 5 FL 5

4.5/2018-Q2 FN30FICO WAC 5.19/ 68 LSZ 324 17.2B/ 5.0B
LTV 81/ 80/ 57 FICO 685 REFI 44/ 32 JMB 3 FT 28
WELLS 16 OTHER 14 NWRES 8 MTRX 7 PENNY 6 LAKEV 6

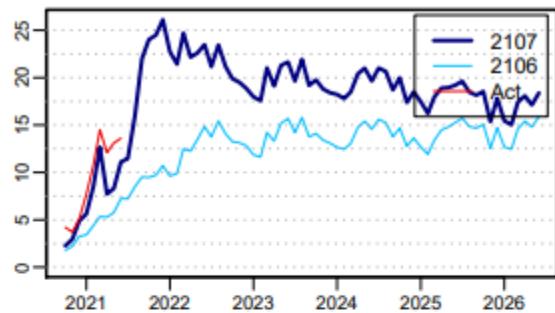


BRO 10 COR 38 RET 52 INV 11 2ND 3 HARP 0 DTI 41
PMI 33/ 8 HR 0 PT NA CA 21 FL 10 TX 10 CO 4 WA 4

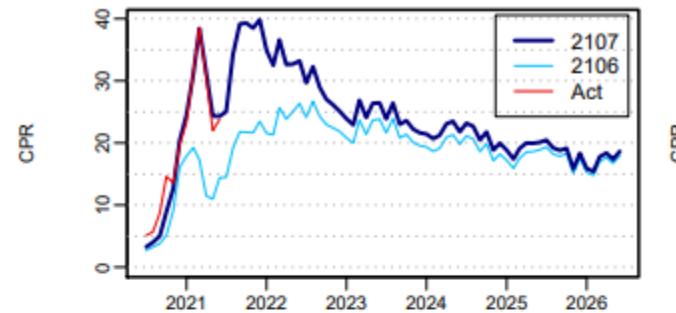
- Model v21.7 weakens ramps on low-credit collateral to partially offset other model speed-ups, but in some cases the new v21.7 ramps still look a little too strong.
- To some extent, it may be more a question of capacity constraints through early 2021, and ramps may move more in line with the new model going forward.

Model Performance Mixed on Investor Cohorts

2.5/2020-Q4 FN30INV100 WAC 3.47/ 30 LSZ 372 14.2B/ 13.0E
 LTV 63/ 63/ 53 FICO 770 REFI 75/ 22 JMB 4 FT 0
 OTHER 43 PENNY 11 MTRX 4 LAKEV 4 QUICK 3 HOMPT 3



3.0/2020-Q3 FN30INV100 WAC 3.94/ 53 LSZ 373 5.9B/ 4.6B
 LTV 66/ 66/ 54 FICO 765 REFI 73/ 29 JMB 3 FT 0
 OTHER 36 PENNY 15 LAKEV 5 QUICK 4 MTRX 4 USB 3



3.5/2020-Q2 FN30INV100 WAC 4.42/ 78 LSZ 387 1.9B/ 1.1B
 LTV 68/ 68/ 54 FICO 760 REFI 65/ 34 JMB 3 FT 0
 OTHER 38 PENNY 14 LAKEV 10 AMHOM 6 USHOR 5 MTRX 3



BRO 20 COR 24 RET 57 INV 100 2ND 0 HARP 0 DTI 36
 PMI 0/ 0 HR 0 PT NA CA 46 WA 7 CO 6 TX 5 AZ 3



BRO 16 COR 30 RET 54 INV 100 2ND 0 HARP 0 DTI 36
 PMI 1/ 0 HR 0 PT NA CA 39 CO 7 WA 6 TX 5 MA 4



BRO 13 COR 33 RET 54 INV 100 2ND 0 HARP 0 DTI 36
 PMI 1/ 0 HR 0 PT NA CA 37 CO 8 MA 5 WA 5 NJ 4



BRO 13 COR 45 RET 41 INV 100 2ND 0 HARP 0 DTI 37
 PMI 1/ 0 HR 0 PT NA CA 34 CO 7 WA 7 FL 5 MA 5

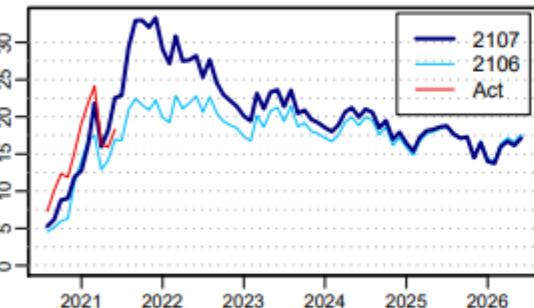
BRO 16 COR 28 RET 56 INV 100 2ND 0 HARP 0 DTI 35
 PMI NA/ NA HR 0 PT NA CA 54 NY 8 MA 4 WA 4 NJ 3

BRO 18 COR 33 RET 49 INV 100 2ND 0 HARP 0 DTI 38
 PMI 1/ 0 HR 0 PT NA CA 36 WA 7 CO 6 FL 6 MA 5

- Model v21.7 tends to be slow on some cohorts (typically new higher coupon) and fast on others (usually the more seasoned vintages).
- Many moving parts here, with the recent limitations on volumes of investor loans that may be delivered to the GSEs, as well as a developing private securitization market.

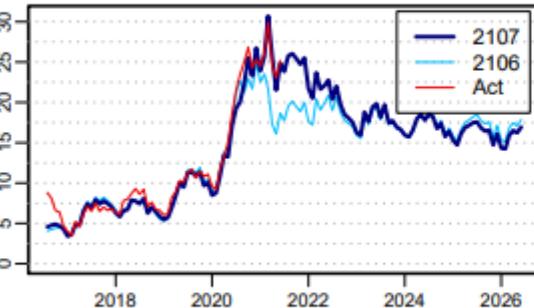
New 15-Year Vintages Appear Relatively Weaker Recently

2.0/2020-Q3 FN15GEN WAC 2.65/ -14 LSZ 301 101.2B/ 82.8E
 LTV 61/ 61/ 49 FICO 770 REFI 93/ 20 JMB 2 FT 2
 OTHER 42 QUICK 12 WELLS 7 MTRX 4 JPM 3 PHH 3



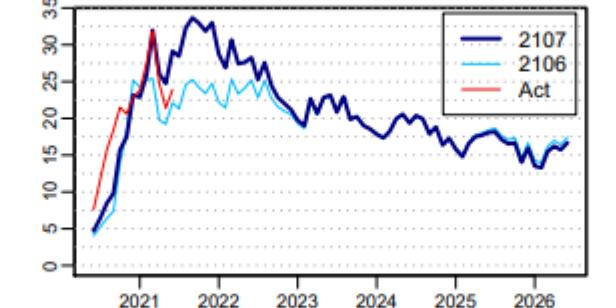
BRO 11 COR 17 RET 73 INV 1 2ND 4 HARP 0 DTI 31
 PMI 5/ 1 HR 0 PT NA CA 15 TX 7 IL 5 FL 4 NJ 4

2.5/2016-Q3 FN15GEN WAC 2.95/ -2 LSZ 270 58.6B/ 22.2B
 LTV 64/ 63/ 29 FICO 764 REFI 82/ 22 JMB 1 FT 5
 OTHER 24 WELLS 12 JPM 6 MTRX 6 NWRES 6 TRUIS 6



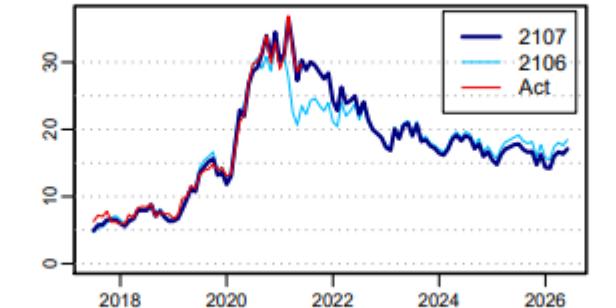
BRO 13 COR 22 RET 65 INV 2 2ND 4 HARP 0 DTI 31
 PMI 1/ 0 HR 0 PT NA CA 17 TX 8 IL 5 FL 4 NJ 4

2.5/2020-Q2 FN15GEN WAC 3.07/ 9 LSZ 261 45.0B/ 33.0B
 LTV 62/ 62/ 48 FICO 760 REFI 91/ 32 JMB 1 FT 2
 OTHER 46 WELLS 8 QUICK 7 JPM 5 MTRX 3 PNC 2



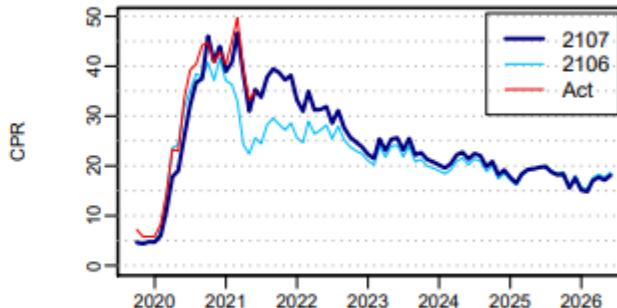
BRO 8 COR 14 RET 79 INV 8 2ND 4 HARP 0 DTI 32
 PMI 5/ 1 HR 0 PT NA CA 10 TX 9 FL 5 NY 5 IL 4

3.0/2017-Q3 FN15GEN WAC 3.43/ 6 LSZ 247 39.3B/ 14.8B
 LTV 66/ 65/ 34 FICO 751 REFI 72/ 30 JMB 1 FT 8
 OTHER 20 WELLS 13 QUICK 9 JPM 7 NWRES 7 MTRX 6



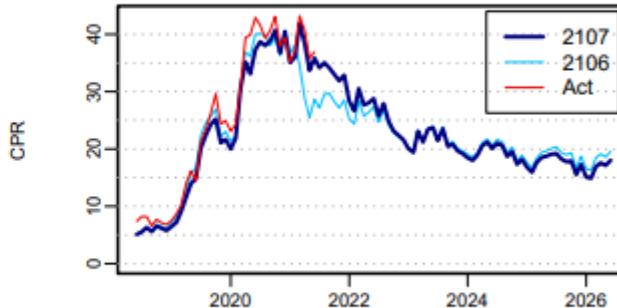
BRO 8 COR 23 RET 69 INV 4 2ND 5 HARP 0 DTI 32
 PMI 2/ 0 HR 0 PT NA CA 12 TX 9 FL 6 NY 5 IL 4

2.5/2019-Q4 FN15GEN WAC 3.13/ -18 LSZ 314 25.0B/ 11.8B
 LTV 65/ 65/ 46 FICO 764 REFI 78/ 19 JMB 1 FT 6
 OTHER 30 WELLS 10 QUICK 7 NWRES 6 JPM 4 PINGR 4



BRO 10 COR 21 RET 70 INV 1 2ND 5 HARP 0 DTI 32
 PMI 6/ 1 HR 0 PT NA CA 12 TX 8 FL 5 IL 4 MN 4

3.5/2018-Q2 FN15GEN WAC 4.06/ 13 LSZ 244 15.7B/ 5.1B
 LTV 65/ 65/ 39 FICO 742 REFI 68/ 36 JMB 0 FT 9
 OTHER 23 WELLS 14 QUICK 11 JPM 6 MTRX 6 NWRES 6



BRO 6 COR 19 RET 76 INV 6 2ND 6 HARP 0 DTI 34
 PMI 4/ 1 HR 0 PT NA TX 11 CA 10 FL 7 NY 6 GA 4

- The 15-year model update proved challenging, as 2021 speeds in the very large new cohorts have been relatively slow recently, in contrast to stronger responses last year.
- The model appears in line recently for most moderately seasoned cohorts, so the recent rally may bring the large 2020 vintages more in line.

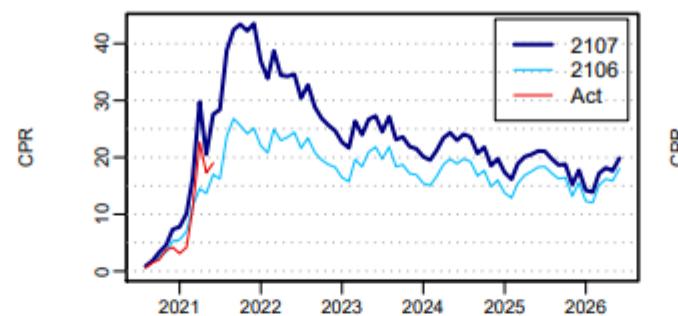
Recent GNMA II Ramp Performance Generally Improved...

2.00/2020-Q3 WAC 2.59 GMA6764M GRP-0.1 1.7B
LSZ 337 CLTV 73 FICO 735 SATO -84 REFI 69



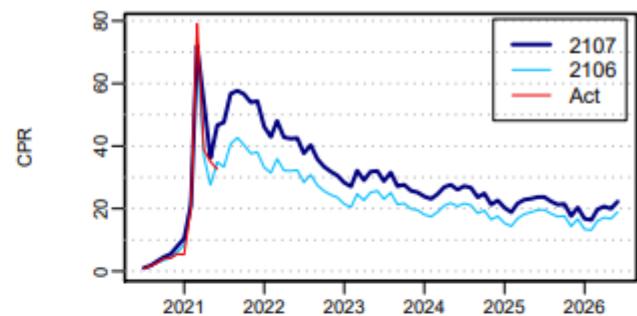
FHA 21 VA 76 RH 1 PLM 0 HARP 0 DTI 40 MB 51
MIP 77/ 19 CA 13 TX 11 FL 10 VA 7 CO 5

2.00/2020-Q3 WAC 2.51 GMA6818M GRP-0.1 8.6B
LSZ 354 CLTV 73 FICO 742 SATO -85 REFI 68



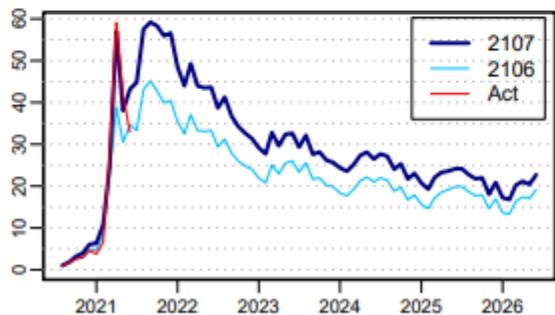
FHA 21 VA 77 RH 1 PLM 0 HARP 0 DTI 40 MB 53
MIP 78/ 19 CA 17 FL 8 TX 8 VA 7 CO 6

2.50/2020-Q3 WAC 2.90 GMA6765M GRP-0.1 25.1B
LSZ 345 CLTV 76 FICO 719 SATO -52 REFI 58



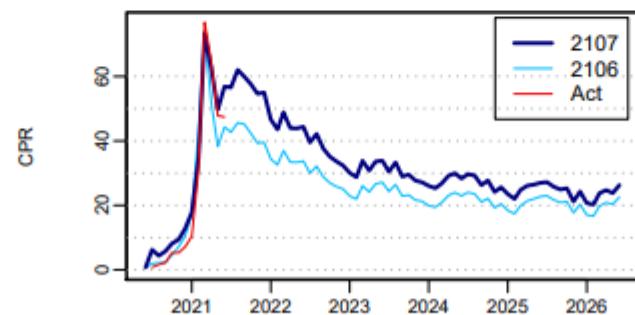
FHA 34 VA 64 RH 1 PLM 0 HARP 0 DTI 40 MB 51
MIP 92/ 29 CA 12 TX 10 FL 9 VA 7 AZ 4

2.50/2020-Q3 WAC 2.89 GMA6819M GRP-0.1 29.0B
LSZ 344 CLTV 77 FICO 716 SATO -46 REFI 53



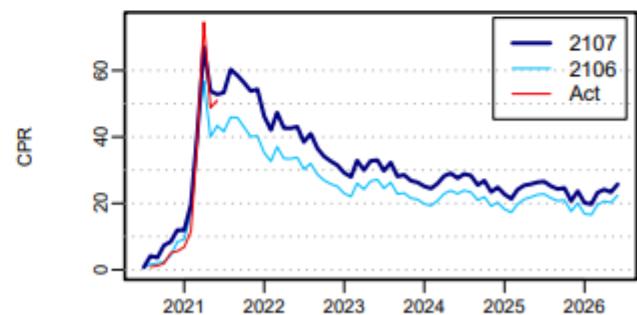
FHA 37 VA 61 RH 0 PLM 0 HARP 0 DTI 41 MB 50
MIP 95/ 31 CA 12 TX 10 FL 9 VA 6 CO 4

3.00/2020-Q3 WAC 3.44 GMA6766M GRP-0.1 10.2B
LSZ 314 CLTV 78 FICO 682 SATO 0 REFI 30



FHA 63 VA 35 RH 1 PLM 4 HARP 0 DTI 42 MB 46
MIP 127/ 53 FL 11 TX 11 CA 10 GA 5 VA 4

3.00/2020-Q3 WAC 3.46 GMA6820M GRP-0.1 7.7B
LSZ 310 CLTV 79 FICO 676 SATO 8 REFI 27



FHA 62 VA 35 RH 2 PLM 7 HARP 0 DTI 42 MB 46
MIP 128/ 53 FL 11 TX 11 CA 10 GA 5 NC 4

- Overall changes to ramp multipliers were modest, and the model generally performs well. Changes to media effect drive faster speeds immediately post-peak.
- Burnout has generally been weakened for GNMAAs, given the assumed strength in FHA-to-conventional refinances. Higher cash-outs driven by HPA are also expected.

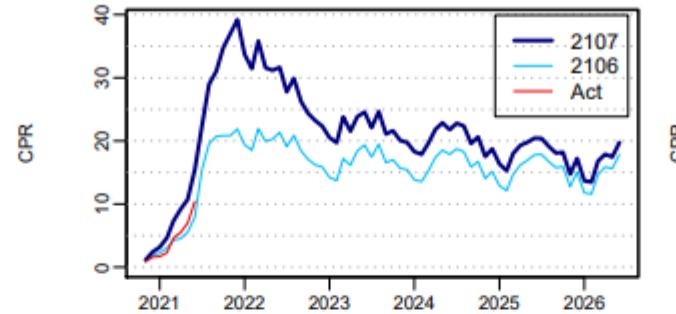
...But New Model Faces Challenges in Some Cases

2.00/2020-Q4 WAC 2.43 GMA6930M GRP-0.1 21.5B
LSZ 363 CLTV 75 FICO 741 SATO -72 REFI 69



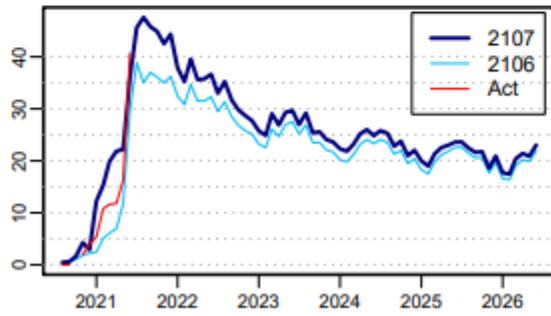
FHA 17 VA 82 RH 0 PLM 0 HARP 0 DTI 40 MB 53
MIP 71/ 14 CA 15 TX 8 VA 8 FL 7 CO 5

2.00/2020-Q4 WAC 2.43 GMA6994M GRP-0.1 26.1B
LSZ 363 CLTV 76 FICO 736 SATO -66 REFI 69



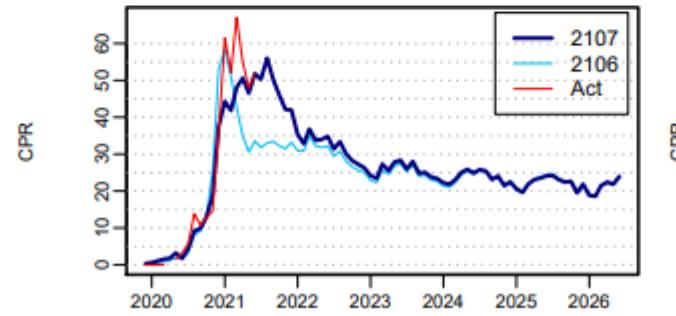
FHA 19 VA 80 RH 0 PLM 0 HARP 0 DTI 40 MB 52
MIP 74/ 16 CA 15 FL 8 TX 8 VA 8 CO 5

3.00/2020-Q3 WAC 3.43 GMA6996M GRP-0.1 2.3B
LSZ 275 CLTV 80 FICO 661 SATO 28 REFI 27



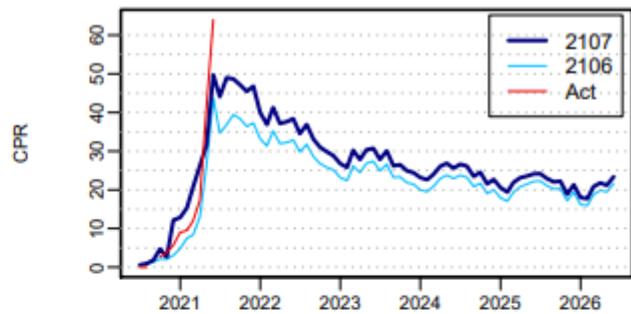
FHA 61 VA 31 RH 7 PLM 32 HARP 0 DTI 42 MB 44
MIP 129/ 53 CA 10 FL 10 TX 8 GA 4 MD 4

3.50/2020-Q1 WAC 3.94 GMA6657M GRP-0.1 2.3B
LSZ 258 CLTV 75 FICO 644 SATO 26 REFI 25



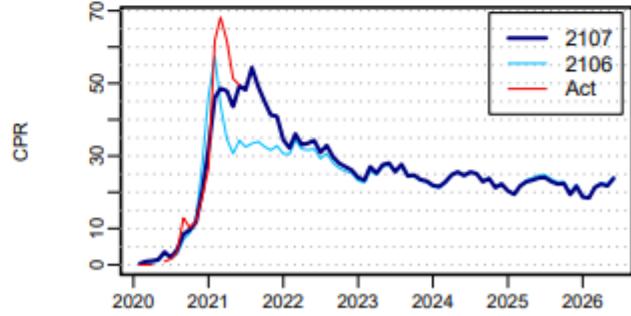
FHA 75 VA 19 RH 4 PLM 33 HARP 0 DTI 43 MB 42
MIP 142/ 64 FL 11 TX 11 CA 9 GA 5 IL 4

3.00/2020-Q3 WAC 3.44 GMA6932M GRP-0.1 3.0B
LSZ 279 CLTV 79 FICO 674 SATO 21 REFI 30



FHA 57 VA 37 RH 5 PLM 23 HARP 0 DTI 42 MB 44
MIP 123/ 49 TX 10 CA 9 FL 9 GA 5 VA 5

3.50/2020-Q1 WAC 3.90 GMA6711M GRP-0.1 2.0B
LSZ 260 CLTV 76 FICO 639 SATO 31 REFI 21

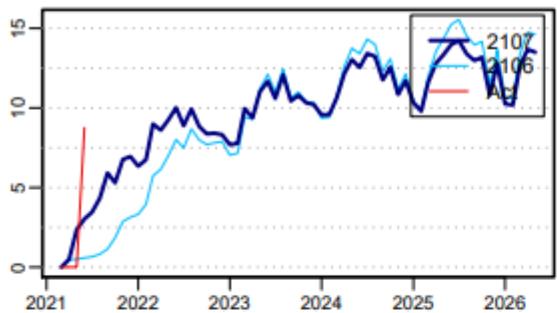


FHA 75 VA 21 RH 2 PLM 40 HARP 0 DTI 42 MB 41
MIP 140/ 63 FL 11 CA 10 TX 10 GA 5 IL 4

- Peak speeds on GNMA 2s have been quite low vs. model so far, but given sharp peak of 40-50 CPR briefly seen in late 2020 and good model performance on recent 2.5s, we did not drop them for now.
- We have added adjustments to pick up early payoff mods (see next page), but in general, the model struggles on pools with high mod fractions. This is a case where separate guarantor models and replines further broken down by “dirty vs. clean” could make a significant difference in model performance.

COVID Mods Refinance Early on Pre-COVID Payment History

3.0/2021 M04: FH:MODI WAC 3.26/ 37 LSZ 258 131MM/ 131MM
LTV 95/ 94/ 90 FICO 654 REFI 0/ 0 JMB 3 FT 0
LAKEV 35 PENNY 24 MNTBK 15 NWRES 9 MDFST 4



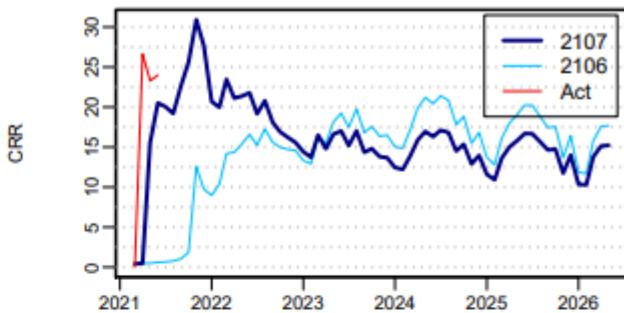
FHA 100 VA 0 RH 0 PLM 100 HARP 0 DTI 44 MB 39
MIP 170/ 82 CA 12 NY 10 FL 9 TX 9 GA 7

3.0/2021 M04: RH:MODI WAC 3.33/ 53 LSZ 172 184MM/ 184MM
LTV 100/ 99/ 95 FICO 663 REFI 0/ 0 JMB 0 FT 0
PENNY 51 NSTAR 13 FREE 8 LAKEV 8 CARRG 7



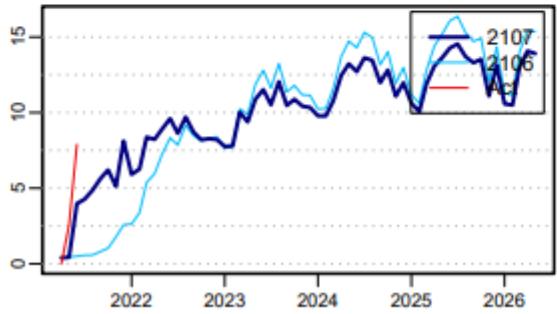
FHA 0 VA 0 RH 100 PLM 100 HARP 0 DTI 38 MB 33
MIP 21/ 8 LA 7 FL 6 NC 6 GA 5 TX 5

3.0/2021 M04: VA:MODI WAC 3.29/ 44 LSZ 317 759MM/ 759MM
LTV 97/ 97/ 93 FICO 670 REFI 0/ 0 JMB 7 FT 0
PENNY 57 FREE 12 LAKEV 6 HOMPT 5 CLBR 4



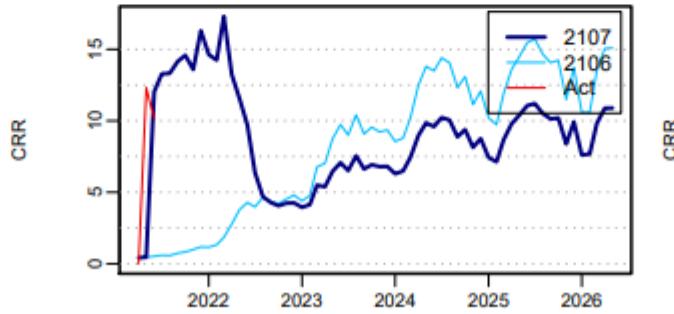
FHA 0 VA 100 RH 0 PLM 100 HARP 0 DTI 42 MB 41
MIP 23/ 0 CA 12 TX 10 FL 9 VA 7 GA 5

3.0/2021 M05: FH:MODI WAC 3.28/ 34 LSZ 270 1.4B/ 1.4B
LTV 96/ 95/ 91 FICO 653 REFI 0/ 0 JMB 3 FT 0
LAKEV 36 PENNY 20 NSTAR 14 MDFST 9 USB 5



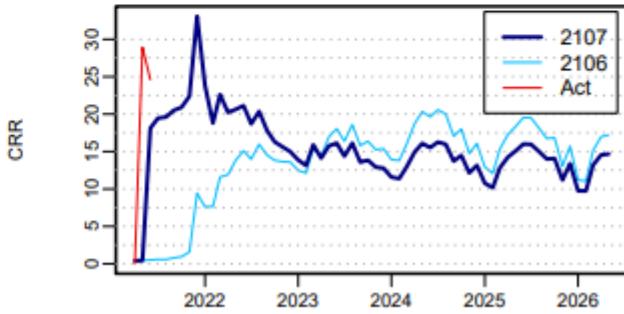
FHA 100 VA 0 RH 0 PLM 100 HARP 0 DTI 44 MB 41
MIP 168/ 84 CA 15 FL 12 TX 11 GA 5 NJ 5

3.0/2021 M05: RH:MODI WAC 3.47/ 61 LSZ 176 192MM/ 192MM
LTV 100/ 100/ 96 FICO 665 REFI 0/ 0 JMB 0 FT 0
PENNY 61 LAKEV 10 NSTAR 6 CARRG 5 HOMPT 5



FHA 0 VA 0 RH 100 PLM 100 HARP 0 DTI 38 MB 32
MIP 36/ 12 FL 6 LA 6 NC 6 TX 6 SC 5

3.0/2021 M05: VA:MODI WAC 3.29/ 39 LSZ 309 567MM/ 567MM
LTV 97/ 97/ 94 FICO 658 REFI 0/ 0 JMB 5 FT 0
PENNY 38 LAKEV 14 WELLS 12 FREE 6 HOMPT 4

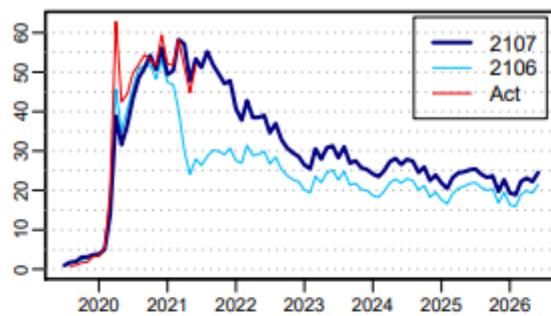


FHA 0 VA 100 RH 0 PLM 100 HARP 0 DTI 42 MB 43
MIP 25/ 0 CA 13 TX 10 FL 9 VA 7 GA 6

- GNMA borrowers receiving COVID-19 forbearance did not have missed payments counted against their clean payment requirements for streamline refinancing.
- Loans that exited forbearance by modification (and were repooled like “new loans” into GNMA multi pools) have therefore refinanced almost immediately in some cases. For example, mod loans from all three major guarantors in April and May 3% multi pools, shown above, have quickly printed strong voluntary speeds.

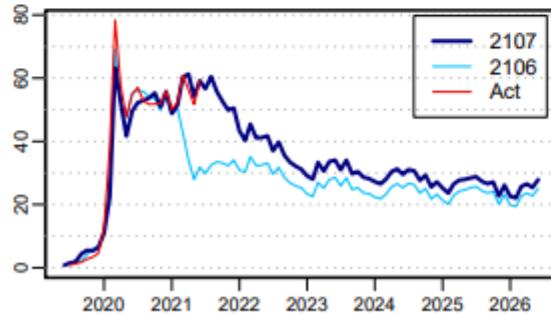
New Model Much Better on Post-Peak GNMA Multis

3.00/2019-Q3 WAC 3.54 GMA6089M GRP-0.1 6.0B
LSZ 340 CLTV 72 FICO 708 SATO -46 REFI 32



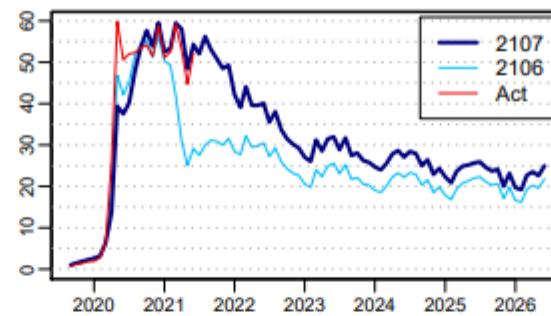
FHA 47 VA 48 RH 3 PLM 0 HARP 0 DTI 41 MB 47
MIP 110/ 41 CA 12 FL 10 TX 8 VA 5 CO 4

3.50/2019-Q3 WAC 4.01 GMA6039M GRP-0.1 4.9B
LSZ 324 CLTV 72 FICO 692 SATO -20 REFI 23



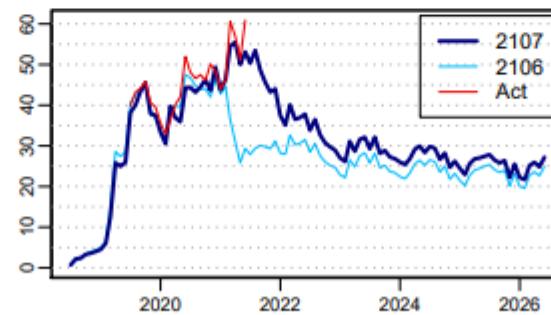
FHA 58 VA 37 RH 3 PLM 1 HARP 0 DTI 43 MB 47
MIP 121/ 50 FL 11 CA 10 TX 9 VA 5 GA 4

3.00/2019-Q4 WAC 3.52 GMA6153M GRP-0.1 8.1B
LSZ 338 CLTV 73 FICO 707 SATO -39 REFI 35



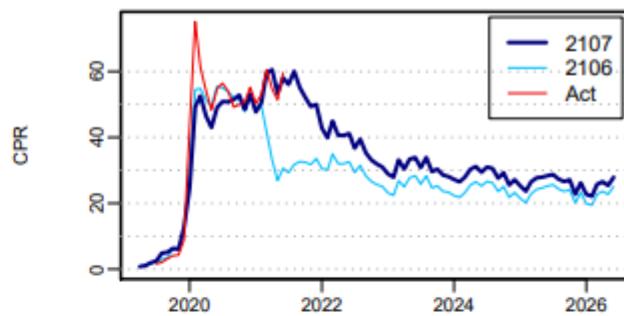
FHA 46 VA 49 RH 3 PLM 0 HARP 0 DTI 41 MB 48
MIP 108/ 40 CA 12 FL 10 TX 8 VA 6 GA 4

4.00/2018-Q3 WAC 4.47 GMA5398M GRP-0.1 3.7B
LSZ 291 CLTV 68 FICO 692 SATO -20 REFI 12



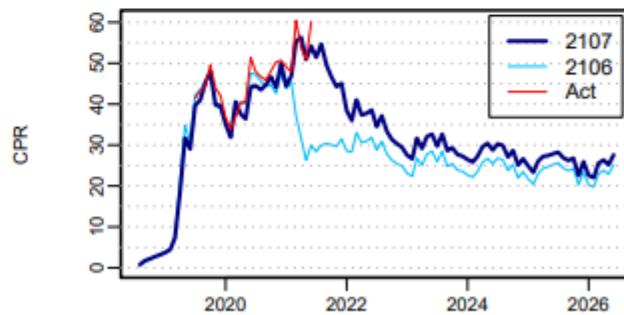
FHA 61 VA 30 RH 8 PLM 11 HARP 0 DTI 42 MB 44
MIP 129/ 54 FL 11 TX 8 CA 6 VA 5 GA 4

3.50/2019-Q2 WAC 4.02 GMA5985M GRP-0.1 4.4B
LSZ 323 CLTV 72 FICO 694 SATO -25 REFI 25



FHA 60 VA 33 RH 5 PLM 2 HARP 0 DTI 42 MB 45
MIP 126/ 53 CA 11 FL 10 TX 8 GA 4 NY 4

4.00/2018-Q3 WAC 4.48 GMA5466M GRP-0.1 3.3B
LSZ 292 CLTV 69 FICO 692 SATO -17 REFI 14

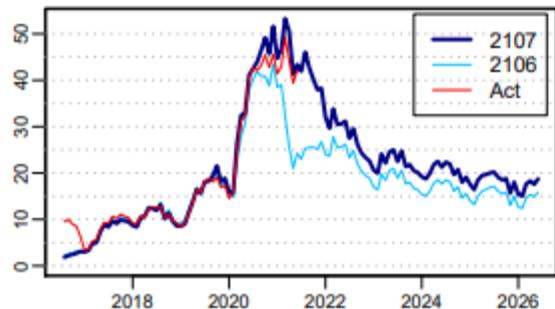


FHA 61 VA 29 RH 8 PLM 7 HARP 0 DTI 42 MB 43
MIP 130/ 54 FL 10 TX 8 CA 6 NY 5 VA 5

- The strong media effect that has sustained itself throughout 2021 so far, despite the rate backup earlier this year, has resulted in much higher post-peak prints on GNMs as well as on conventionals versus the prior production model.
- Model v21.7 also incorporates slower burnout, particularly on FHA collateral, which has printed very strong after a lull in some cases during the early part of the COVID crisis.

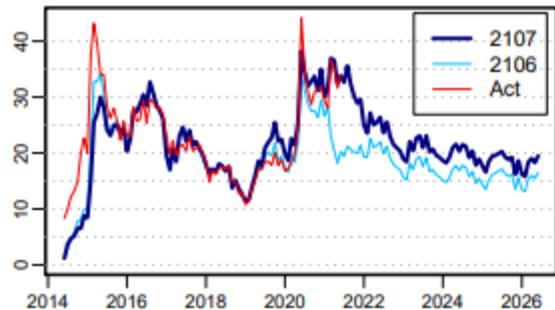
Seasoned GNMA IIs Affected by Media Effect and Buyouts

3.0/2016-Q3 GNIIMULTI WAC 3.41/-27 LSZ 280 213.8B/ 62.01
 LTV 95/ 95/ 57 FICO 704 REFI 33/ 8 JMB 2 FT 42
 PENNY 16 LAKEV 15 FREE 15 OTHER 8 WELLS 7 USAA 5



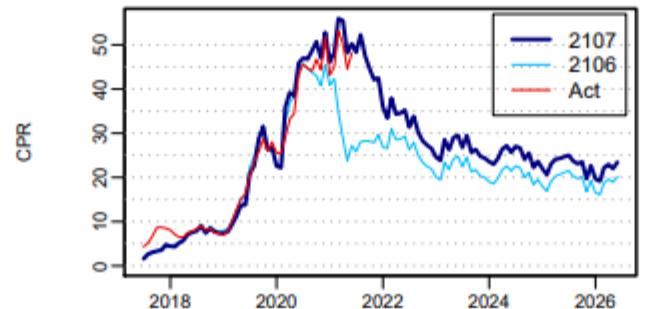
FHA 51 VA 42 RH 6 PLM 1 HARP 0 DTI 40
 MIP 126/ 45 CA 9 TX 8 FL 7 VA 6 GA 4

4.0/2014-Q2 GNIIMULTI WAC 4.35/ -0 LSZ 234 114.6B/ 15.4E
 LTV 94/ 94/ 49 FICO 670 REFI 19/ 3 JMB 0 FT 40
 WELLS 18 LAKEV 13 FREE 12 PENNY 10 OTHER 7 NSTAR 5



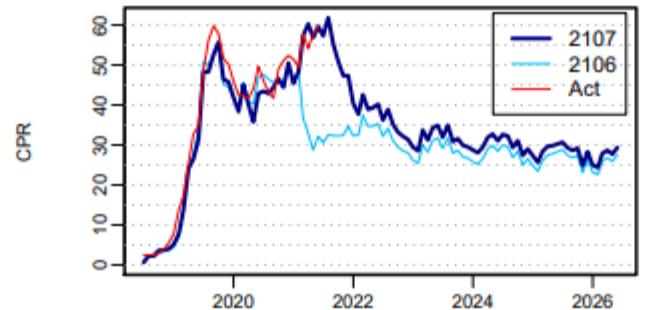
FHA 68 VA 18 RH 12 PLM 22 HARP 0 DTI 39
 MIP 132/ 73 TX 11 CA 7 FL 7 NY 6 GA 4

3.5/2017-Q3 GNIIMULTI WAC 3.90/ -22 LSZ 280 197.0B/ 57.91
 LTV 95/ 95/ 63 FICO 693 REFI 24/ 11 JMB 1 FT 50
 FREE 15 PENNY 13 LAKEV 13 OTHER 8 NSTAR 5 USAA 5



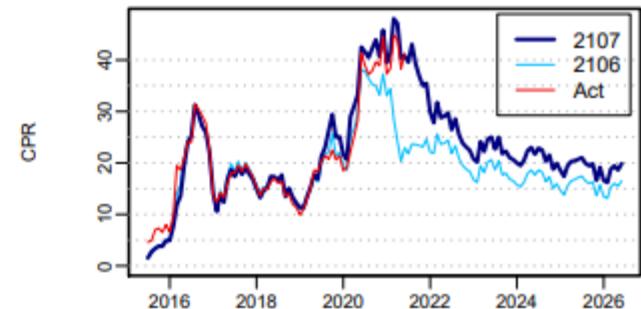
FHA 59 VA 32 RH 7 PLM 3 HARP 0 DTI 41
 MIP 128/ 52 CA 9 TX 9 FL 8 VA 5 GA 4

4.5/2018-Q3 GNIIMULTI WAC 4.94/ 29 LSZ 288 79.9B/ 16.7B
 LTV 96/ 96/ 70 FICO 661 REFI 13/ 10 JMB 1 FT 60
 FREE 16 LAKEV 15 OTHER 13 PENNY 8 NSTAR 6 QUICK 4



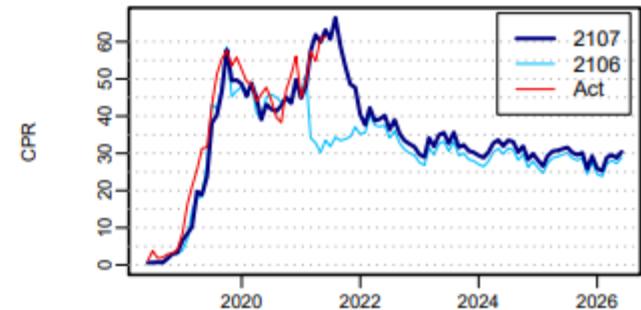
FHA 73 VA 20 RH 5 PLM 8 HARP 0 DTI 44
 MIP 142/ 63 FL 13 TX 11 CA 9 GA 5 NY 5

3.5/2015-Q3 GNIIMULTI WAC 3.88/ -12 LSZ 261 200.7B/ 40.01
 LTV 94/ 94/ 53 FICO 689 REFI 29/ 6 JMB 1 FT 43
 PENNY 15 FREE 14 LAKEV 12 WELLS 11 OTHER 7 NSTAR 5



FHA 67 VA 26 RH 6 PLM 6 HARP 0 DTI 40
 MIP 140/ 59 CA 9 TX 9 FL 7 NY 5 VA 5

5.0/2018-Q3 GNIIMULTI WAC 5.49/ 81 LSZ 274 30.4B/ 6.4B
 LTV 96/ 96/ 70 FICO 637 REFI 13/ 10 JMB 1 FT 68
 OTHER 19 LAKEV 16 FREE 15 NSTAR 8 MNSRC 6 PENNY 4

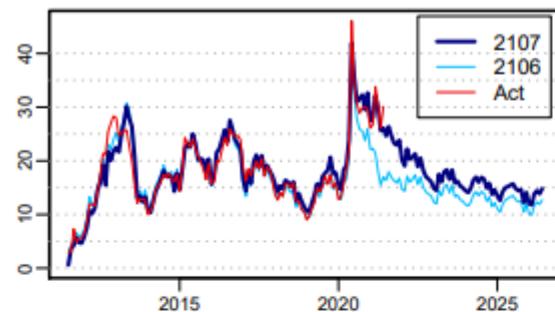


FHA 79 VA 17 RH 3 PLM 2 HARP 1 DTI 44
 MIP 147/ 67 FL 13 TX 13 CA 10 GA 5 NJ 4

- In most cases, both voluntary and involuntary projections are higher in v21.7 versus v21.6 on moderately seasoned GNMA cohorts.
- We do expect prepayments to drop off fairly sharply in 2022, as most remaining DQs go through buyout or modification over the remainder of 2021 and early 2022.

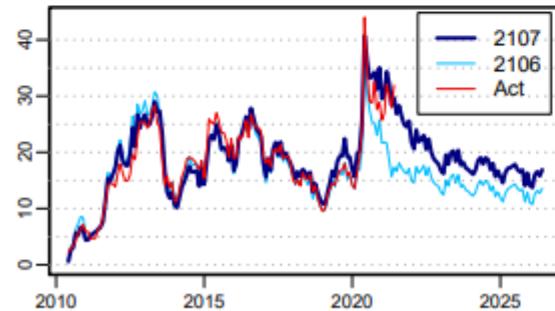
Double/Triple MIP GNMA IIs Faster on Lower Burnout

4.0/2011-Q3 GNII WAC 4.35/-20 LSZ 235 80.3B/ 8.1B
LTV 95/ 95/ 41 FICO 701 REFI 29/ 0 JMB 0 FT 33
WELLS 39 LAKEV 16 JPM 7 NSTAR 6 USB 4 CARRG 4



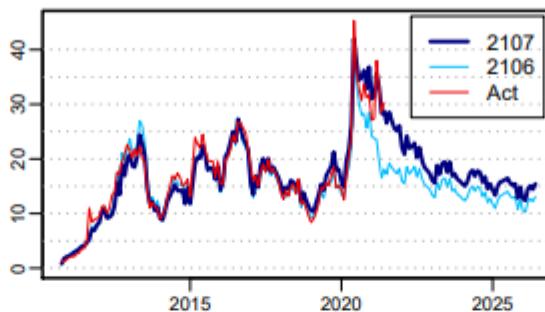
FHA 67 VA 20 RH 11 PLM 6 HARP 0 DTI NA
MIP 99/ 66 TX 8 CA 7 FL 6 NY 6 GA 4

4.5/2010-Q2 GNII WAC 4.87/ -8 LSZ 234 88.0B/ 7.1B
LTV 94/ 94/ 42 FICO 699 REFI 29/ 0 JMB 0 FT 40
WELLS 30 LAKEV 15 NSTAR 14 JPM 6 CARRG 6 PHH 4



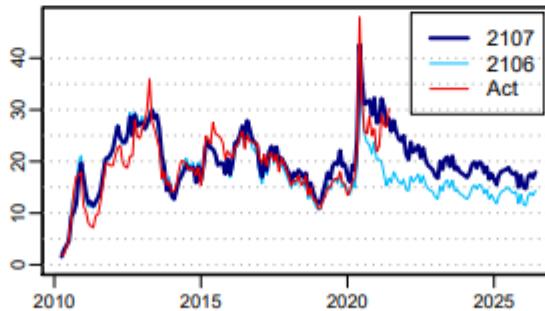
FHA 83 VA 10 RH 5 PLM 4 HARP 0 DTI NA
MIP 173/ 45 TX 8 CA 7 NY 6 FL 5 GA 5

4.0/2010-Q4 GNII WAC 4.39/ -23 LSZ 248 35.4B/ 3.6B
LTV 94/ 95/ 41 FICO 712 REFI 30/ 0 JMB 0 FT 33
WELLS 36 LAKEV 18 JPM 6 NSTAR 6 USB 5 OTHER 5



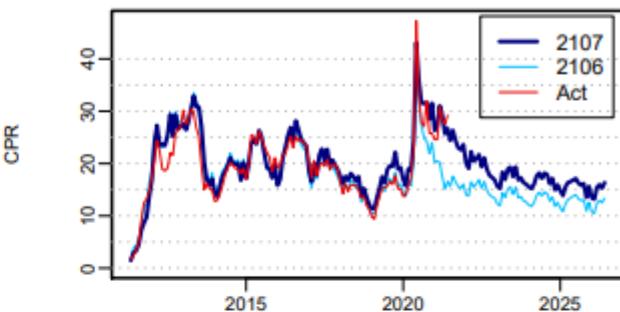
FHA 76 VA 15 RH 7 PLM 3 HARP 0 DTI NA
MIP 172/ 43 CA 7 TX 7 FL 5 GA 4 IL 4

5.0/2010-Q2 GNII WAC 5.30/ 18 LSZ 215 78.9B/ 5.5B
LTV 94/ 94/ 42 FICO 679 REFI 27/ 0 JMB 0 FT 46
WELLS 33 NSTAR 15 CARRG 14 LAKEV 9 JPM 6 PHH 4



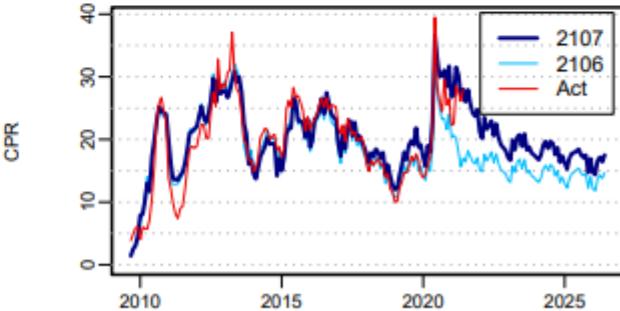
FHA 87 VA 5 RH 6 PLM 5 HARP 2 DTI NA
MIP 164/ 48 TX 10 CA 8 FL 7 NY 7 PA 5

4.5/2011-Q2 GNII WAC 4.82/ -4 LSZ 219 78.5B/ 6.6B
LTV 94/ 94/ 41 FICO 690 REFI 26/ 0 JMB 0 FT 39
WELLS 39 LAKEV 15 CARRG 9 JPM 7 NSTAR 4 OTHER 4



FHA 76 VA 12 RH 10 PLM 8 HARP 0 DTI NA
MIP 103/ 67 TX 10 CA 7 NY 7 FL 6 GA 4

5.0/2009-Q3 GNII WAC 5.37/ 10 LSZ 222 70.3B/ 4.0B
LTV 94/ 94/ 42 FICO 672 REFI 30/ 0 JMB 0 FT 43
WELLS 25 NSTAR 17 LAKEV 14 CARRG 11 PHH 6 JPM 5

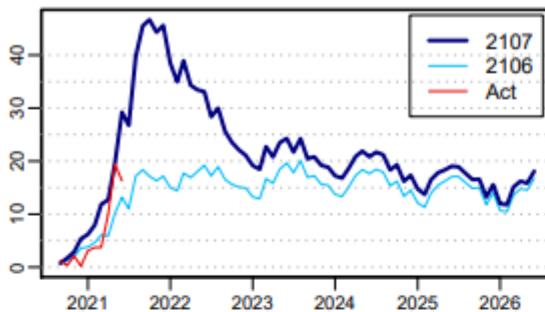


FHA 84 VA 6 RH 9 PLM 2 HARP 13 DTI NA
MIP 151/ 45 TX 9 CA 6 FL 6 NY 5 PA 5

- Buyouts on Wells Fargo tended to push up involuntary speeds initially, but this has settled down because new delinquencies have fallen off sharply.
- Voluntary speeds, while slow early in the COVID crisis, have picked up in recent months and should continue to be supported by refinances into conventional loans.

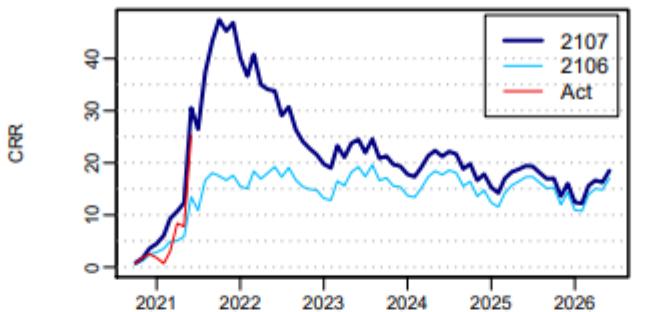
Model v21.7 Generally In Line on New G2 Jumbo Pools

2.00/2020-Q4 WAC 2.48 GMA6885M GRP-0.1 1.0B
LSZ 701 CLTV 74 FICO 752 SATO -75 REFI 67



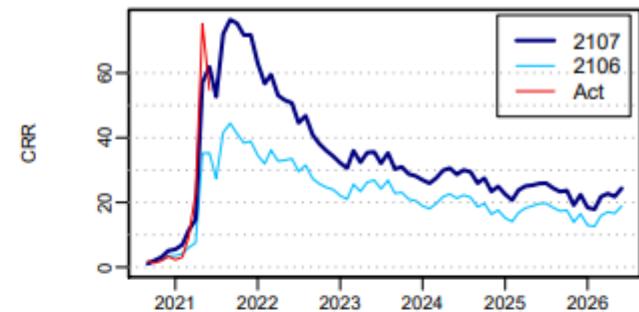
FHA 4 VA 95 RH 0 PLM 0 HARP 0 DTI 41 MB 70
MIP 56/ 4 CA 47 VA 15 MD 6 CO 5 WA 4

2.00/2020-Q4 WAC 2.46 GMA6921M GRP-0.1 1.5B
LSZ 736 CLTV 75 FICO 750 SATO -70 REFI 63



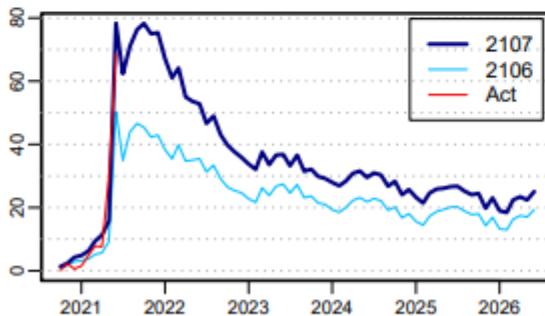
FHA 6 VA 93 RH 0 PLM 0 HARP 0 DTI 41 MB 69
MIP 58/ 6 CA 43 VA 15 MD 7 WA 5 CO 4

2.50/2020-Q4 WAC 2.84 GMA6855M GRP-0.1 1.3B
LSZ 757 CLTV 77 FICO 741 SATO -40 REFI 43



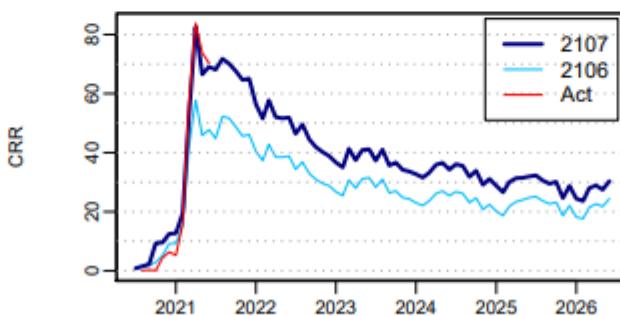
FHA 13 VA 86 RH 0 PLM 0 HARP 0 DTI 42 MB 67
MIP 67/ 12 CA 38 VA 15 MD 6 WA 6 CO 4

2.50/2020-Q4 WAC 2.84 GMA6922M GRP-0.1 1.4B
LSZ 736 CLTV 77 FICO 737 SATO -33 REFI 46



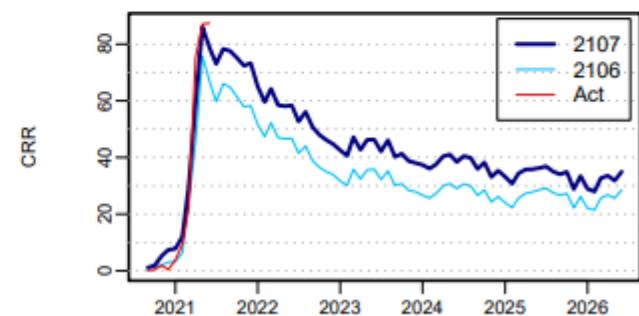
FHA 12 VA 87 RH 0 PLM 0 HARP 0 DTI 42 MB 67
MIP 66/ 12 CA 37 VA 14 MD 6 WA 6 CO 4

3.00/2020-Q3 WAC 3.39 GMA6810M GRP-0.1 280MM
LSZ 717 CLTV 79 FICO 714 SATO -4 REFI 15



FHA 28 VA 71 RH 0 PLM 1 HARP 0 DTI 43 MB 63
MIP 86/ 26 CA 34 MD 9 VA 9 WA 9 TX 7

3.00/2020-Q4 WAC 3.51 GMA6856M GRP-0.1 114MM
LSZ 680 CLTV 79 FICO 692 SATO 23 REFI 13

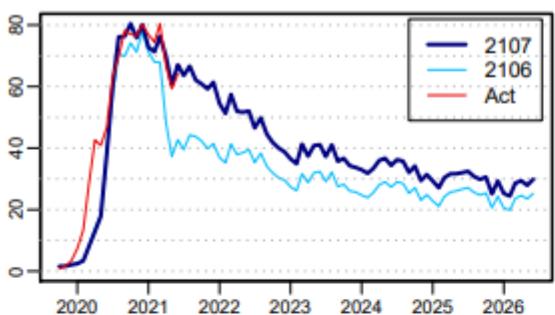


FHA 49 VA 50 RH 0 PLM 4 HARP 0 DTI 44 MB 61
MIP 112/ 44 CA 41 WA 9 MD 8 TX 6 NY 5

- Peak ramp speeds on MJMs have been very strong overall. But similar to conforming FHA/VA loans, the new model generally appears fast on 2s so far.
- But for 2.5s and above, the new model captures the speeds (which often peak well above 90 CPR for VA loans) much more accurately.

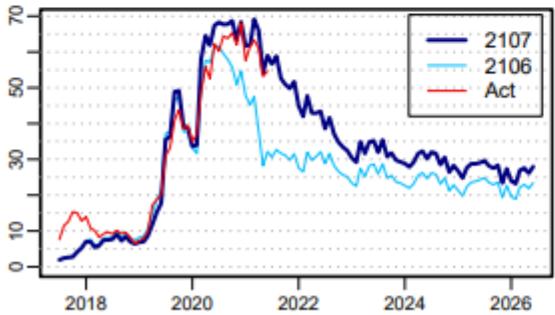
Model v21.7 Seasoned G2 Jumbo Projections Improve

3.0/2019-Q4 GNIIJUMBO WAC 3.49/ -38 LSZ 672 6.7B/ 1.3B
LTV 94/ 93/ 72 FICO 718 REFI 50/ 11 JMB 70 FT 25
LAKEV 16 OTHER 14 NAVY 11 FREE 8 TRUIS 8 PENNY 7



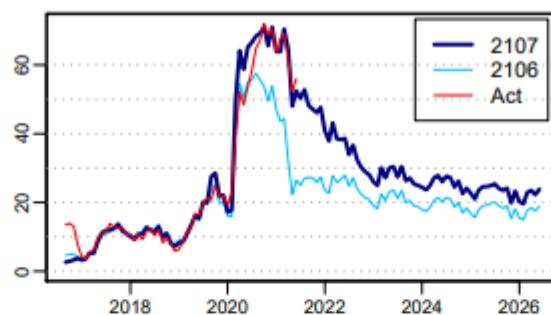
FHA 31 VA 68 RH 0 PLM 0 HARP 0 DTI 43
MIP 88/ 28 CA 47 VA 12 MD 6 NY 6 WA 5

3.5/2017-Q3 GNIIJUMBO WAC 3.90/ -20 LSZ 569 10.9B/ 1.4E
LTV 94/ 94/ 62 FICO 704 REFI 23/ 14 JMB 37 FT 44
LAKEV 23 FREE 16 PENNY 10 NWRES 9 TRUIS 7 WELLS 6



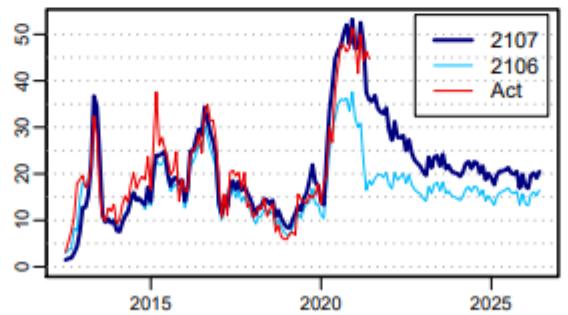
FHA 53 VA 46 RH 0 PLM 1 HARP 0 DTI 44
MIP 117/ 46 CA 39 NY 15 VA 10 MD 8 NJ 4

3.0/2016-Q3 GNIIJUMBO WAC 3.40/ -29 LSZ 576 18.2B/ 2.6E
LTV 92/ 92/ 56 FICO 723 REFI 49/ 13 JMB 40 FT 23
LAKEV 22 FREE 13 PENNY 10 USB 9 WELLS 6 NWRES 5



FHA 29 VA 70 RH 0 PLM 0 HARP 0 DTI 41
MIP 86/ 24 CA 36 VA 18 MD 10 NY 6 WA 4

3.5/2012-Q2 GNIIJUMBO WAC 3.82/ -12 LSZ 520 6.6B/ 491MI
LTV 92/ 92/ 40 FICO 735 REFI 54/ 3 JMB 27 FT 13
WELLS 48 USAA 13 LAKEV 8 JPM 7 NAVY 4 TRUIS 4



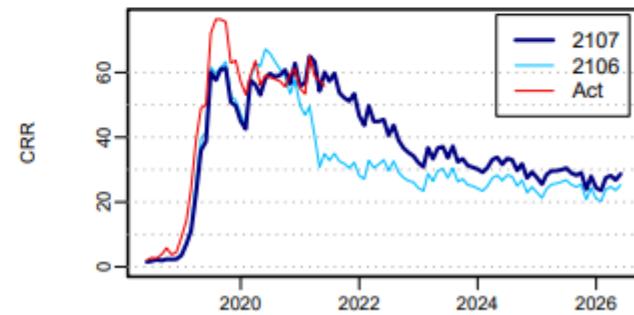
FHA 45 VA 53 RH 0 PLM 0 HARP 0 DTI 35
MIP 79/ 49 CA 23 VA 22 MD 13 NY 13 NJ 5

3.5/2019-Q3 GNIIJUMBO WAC 4.00/ -2 LSZ 635 4.3B/ 692MN
LTV 95/ 95/ 73 FICO 689 REFI 37/ 12 JMB 65 FT 37
LAKEV 16 OTHER 16 FREE 12 NWRES 8 PENNY 7 HOMBR 6



FHA 58 VA 41 RH 0 PLM 1 HARP 0 DTI 46
MIP 122/ 52 CA 48 NY 12 VA 6 WA 6 MD 5

4.0/2018-Q3 GNIIJUMBO WAC 4.50/ -6 LSZ 610 5.6B/ 478MN
LTV 94/ 94/ 68 FICO 690 REFI 19/ 15 JMB 46 FT 54
LAKEV 24 FREE 17 OTHER 12 FSTAR 7 CLBR 6 HOMPT 5

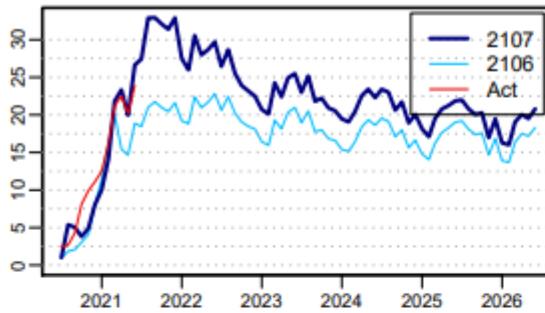


FHA 62 VA 37 RH 0 PLM 2 HARP 0 DTI 46
MIP 127/ 54 CA 38 NY 23 VA 7 MD 5 WA 4

- Peak speeds on seasoned GNMA II MJMs have substantially exceeded v21.6 projections; borrower response on more seasoned vintages in particular have been extremely strong versus the past.
- As for conventionals, more and more seasoned GNMA jumbos are now under the conforming limit of \$548,250; this may partly explain the higher speeds.

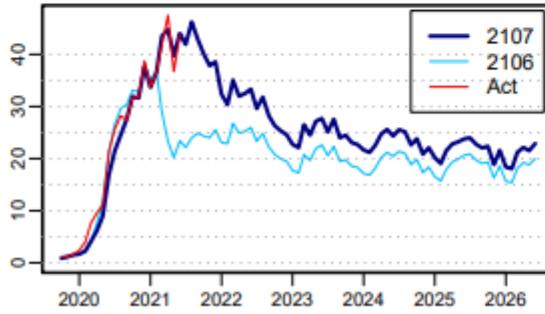
GNMA II New Custom Higher Loan Balance Specs

3.0/2020-Q3 GNIIHLB WAC 3.46/ 1 LSZ 160 5.1B/ 4.3B
 LTV 96/ 96/ 80 FICO 684 REFI 28/ 6 JMB 0 FT 56
 OTHER 24 PENNY 16 LAKEV 8 AMHOM 7 USB 5 CLBR 5



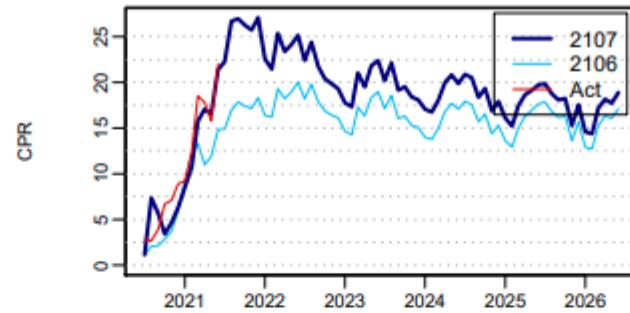
FHA 71 VA 22 RH 6 PLM 0 HARP 0 DTI 41
 MIP 142/ 62 TX 13 FL 8 GA 6 IN 5 NC 5

3.5/2019-Q4 GNIIHLB WAC 3.99/ 13 LSZ 161 4.2B/ 2.5B
 LTV 96/ 96/ 75 FICO 676 REFI 24/ 10 JMB 0 FT 59
 PENNY 26 OTHER 13 LAKEV 10 AMHOM 7 CLBR 6 NSTAR 5



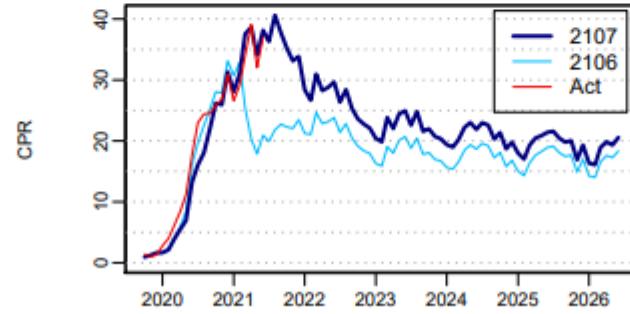
FHA 70 VA 20 RH 9 PLM 0 HARP 0 DTI 41
 MIP 142/ 62 TX 10 FL 8 GA 7 OH 5 PA 5

3.0/2020-Q3 GNIIHLB WAC 3.46/ 1 LSZ 129 5.9B/ 5.2B
 LTV 95/ 94/ 79 FICO 683 REFI 28/ 8 JMB 0 FT 58
 OTHER 24 PENNY 15 LAKEV 9 AMHOM 6 CLBR 5 USB 4



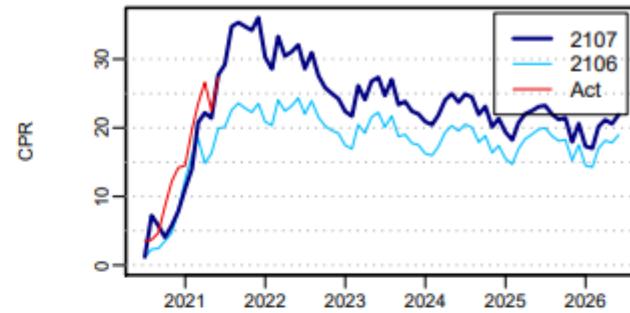
FHA 69 VA 20 RH 9 PLM 0 HARP 0 DTI 39
 MIP 142/ 62 TX 9 OH 8 FL 6 IN 6 GA 5

3.5/2019-Q4 GNIIHLB WAC 3.98/ 10 LSZ 130 5.3B/ 3.5B
 LTV 95/ 94/ 74 FICO 679 REFI 26/ 13 JMB 0 FT 59
 PENNY 23 OTHER 13 LAKEV 10 QUICK 7 AMHOM 7 NSTAR 6



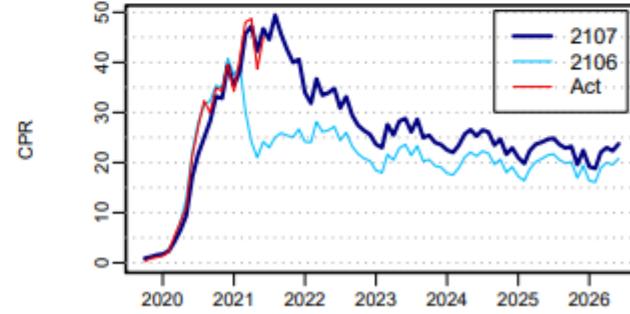
FHA 68 VA 17 RH 13 PLM 0 HARP 0 DTI 40
 MIP 141/ 62 OH 8 FL 6 GA 6 PA 6 TX 6

3.0/2020-Q3 GNIMAX200K WAC 3.46/ 2 LSZ 184 4.0B/ 3.4B
 LTV 96/ 96/ 80 FICO 685 REFI 27/ 6 JMB 0 FT 57
 OTHER 25 AMHOM 9 PENNY 8 LAKEV 8 USB 7 CLBR 6



FHA 72 VA 21 RH 5 PLM 0 HARP 0 DTI 42
 MIP 144/ 63 TX 17 FL 9 GA 6 NC 4 OH 4

3.5/2019-Q4 GNIMAX200K WAC 3.98/ 16 LSZ 185 2.9B/ 1.7B
 LTV 96/ 96/ 75 FICO 676 REFI 24/ 10 JMB 0 FT 60
 PENNY 32 OTHER 14 CLBR 7 LAKEV 7 HOMPT 6 AMHOM 5

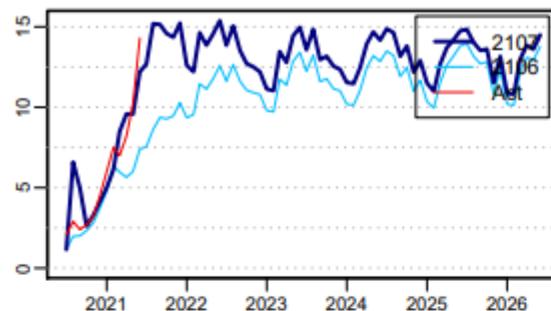


FHA 66 VA 21 RH 12 PLM 0 HARP 0 DTI 41
 MIP 138/ 60 TX 12 FL 10 GA 6 NC 5 AZ 4

- Custom loan balance cohort-level projections look more reasonable in model v21.7, affected by similar drivers as generic collateral.
- Higher loan balance segments in custom GNMAAs may be disproportionately affected by VA loans, which make up about 20% of the pools, and which may print initial peak speeds of 50+ CPR.

GNMA II New Custom Lower Loan Balance Specs

3.0/2020-Q3 GNIILLB WAC 3.46/ 6 LSZ 71 706MM/ 652MM
 LTV 91/ 91/ 77 FICO 686 REFI 28/ 11 JMB 0 FT 58
 QUICK 20 PENNY 19 OTHER 17 NSTAR 6 LAKEV 6 USB 5



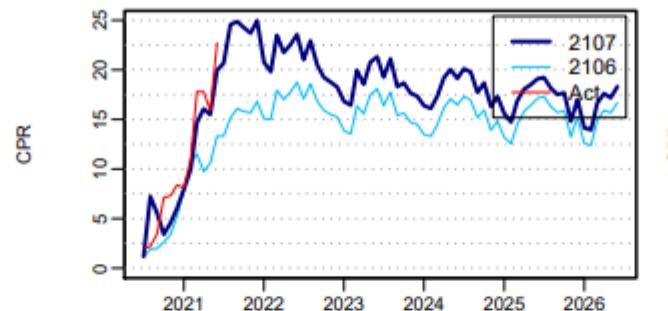
FHA 66 VA 15 RH 17 PLM 0 HARP 0 DTI 36
 MIP 142/ 61 OH 13 IN 9 IL 8 MI 7 MO 6

3.5/2019-Q4 GNIILLB WAC 3.97/ 12 LSZ 71 692MM/ 541MM
 LTV 90/ 90/ 71 FICO 686 REFI 26/ 18 JMB 0 FT 60
 PENNY 24 QUICK 22 OTHER 10 LAKEV 6 CLBR 5 NSTAR 5



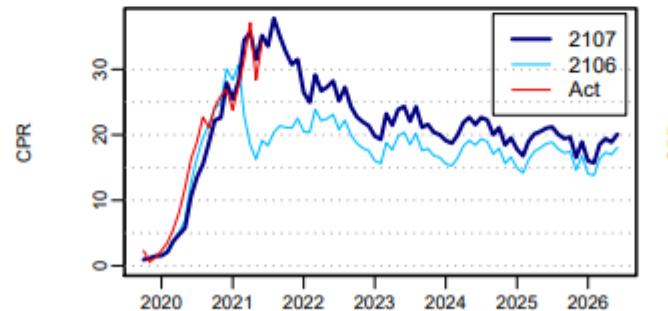
FHA 62 VA 13 RH 23 PLM 0 HARP 0 DTI 36
 MIP 140/ 60 OH 13 IN 7 PA 7 IL 6 MI 6

3.0/2020-Q3 GNIIHLB WAC 3.46/ 1 LSZ 115 1.6B/ 1.4B
 LTV 94/ 93/ 78 FICO 682 REFI 32/ 10 JMB 0 FT 54
 OTHER 24 PENNY 16 QUICK 8 AMHOM 7 NSTAR 6 LAKEV 6



FHA 69 VA 18 RH 11 PLM 0 HARP 0 DTI 39
 MIP 143/ 62 OH 11 IN 7 TX 6 FL 5 GA 5

3.5/2019-Q4 GNIIHLB WAC 3.97/ 10 LSZ 116 1.4B/ 967MM
 LTV 94/ 94/ 74 FICO 678 REFI 26/ 15 JMB 0 FT 60
 PENNY 26 OTHER 12 QUICK 11 LAKEV 9 AMHOM 7 NSTAR 6



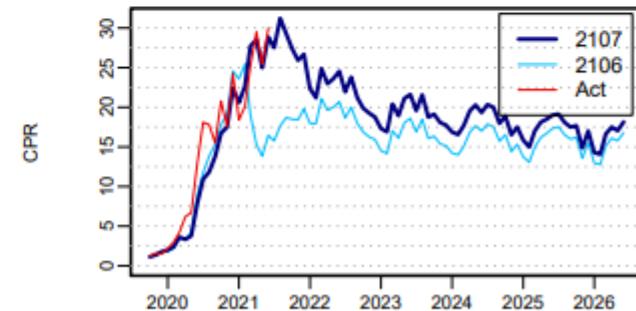
FHA 67 VA 15 RH 17 PLM 0 HARP 0 DTI 39
 MIP 142/ 62 OH 10 IN 6 MI 6 PA 6 FL 5

3.0/2020-Q3 GNIIMLB WAC 3.46/ 4 LSZ 96 1.8B/ 1.6B
 LTV 93/ 92/ 78 FICO 684 REFI 30/ 10 JMB 0 FT 56
 OTHER 22 PENNY 15 QUICK 10 NSTAR 7 LAKEV 6 AMHOM 5



FHA 66 VA 16 RH 16 PLM 0 HARP 0 DTI 37
 MIP 141/ 61 OH 11 IN 9 IL 6 MI 6 MO 5

3.5/2019-Q4 GNIIMLB WAC 3.97/ 10 LSZ 96 1.5B/ 1.1B
 LTV 92/ 92/ 73 FICO 683 REFI 26/ 17 JMB 0 FT 60
 PENNY 22 QUICK 12 OTHER 12 LAKEV 10 NSTAR 6 AMHOM 5

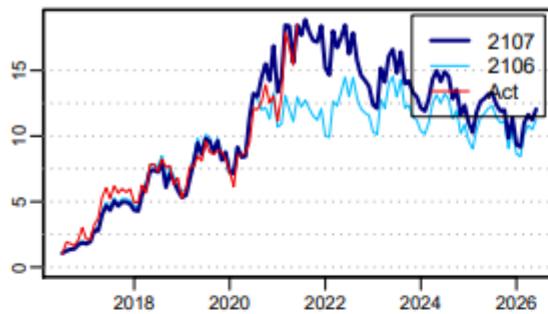


FHA 63 VA 14 RH 21 PLM 0 HARP 0 DTI 38
 MIP 140/ 60 OH 10 IN 6 MI 6 PA 6 GA 5

- As for conventionals, the lower loan balance categories still offer significant call protection, but voluntary speeds have been coming in at almost double the levels of previous rallies.
- Buyouts are a large fraction of speeds on these pools, so buyout model projections are quite important to their valuations; buyout model changes are discussed in the COVID section below.

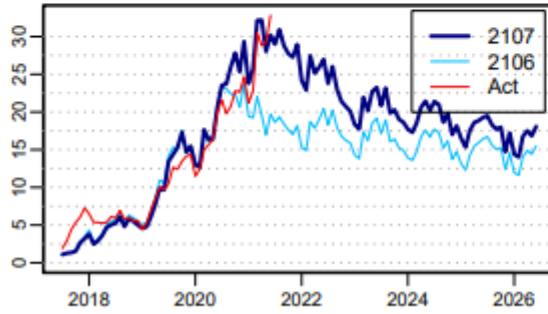
GNMA II Seasoned Loan Balance Specs

3.5/2016-Q3 GNIILLB WAC 3.90/ 16 LSZ 70 2.4B/ 1.3B
LTV 93/ 93/ 56 FICO 685 REFI 24/ 9 JMB 0 FT 62
QUICK 18 LAKEV 12 PENNY 11 FREE 9 OTHER 7 WELLS 6



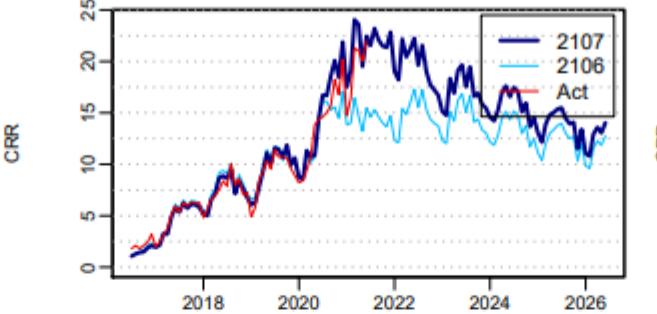
FHA 67 VA 11 RH 19 PLM 0 HARP 0 DTI 36
MIP 173/ 65 OH 11 IN 9 MI 8 IL 6 PA 6

4.0/2017-Q3 GNIILLB WAC 4.39/ 25 LSZ 129 9.9B/ 4.4B
LTV 96/ 96/ 64 FICO 672 REFI 16/ 7 JMB 0 FT 71
PENNY 19 LAKEV 19 OTHER 9 NSTAR 7 FREE 6 HFAGY 5



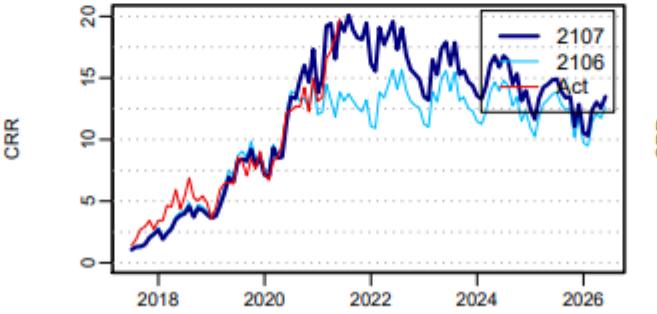
FHA 73 VA 11 RH 14 PLM 0 HARP 0 DTI 40
MIP 146/ 66 TX 13 FL 7 GA 6 OH 6 IN 5

3.5/2016-Q3 GNIILMB WAC 3.89/ 16 LSZ 97 3.7B/ 1.8B
LTV 94/ 94/ 57 FICO 683 REFI 26/ 6 JMB 0 FT 60
PENNY 17 LAKEV 13 WELLS 9 NSTAR 9 QUICK 8 FREE 8



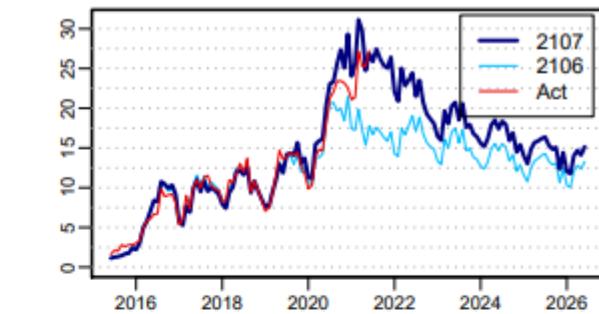
FHA 70 VA 12 RH 16 PLM 0 HARP 0 DTI 37
MIP 167/ 66 OH 9 TX 8 IN 6 MI 6 FL 5

4.0/2017-Q2 GNIILLB WAC 4.40/ 27 LSZ 70 2.3B/ 1.3B
LTV 94/ 94/ 62 FICO 677 REFI 18/ 8 JMB 0 FT 69
PENNY 15 LAKEV 15 QUICK 12 OTHER 10 NSTAR 8 FREE 8



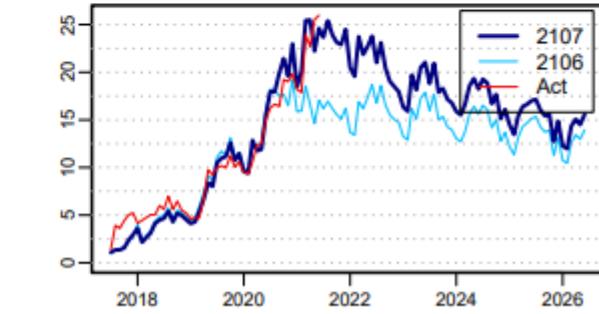
FHA 65 VA 10 RH 24 PLM 0 HARP 0 DTI 36
MIP 139/ 62 OH 11 IN 9 MI 8 IL 6 PA 6

3.5/2015-Q2 GNIILLB WAC 3.88/ -11 LSZ 129 4.7B/ 1.6B
LTV 96/ 96/ 53 FICO 701 REFI 21/ 4 JMB 0 FT 63
WELLS 50 LAKEV 18 NSTAR 6 TRUIS 5 USB 4 PNC 3



FHA 55 VA 22 RH 21 PLM 0 HARP 0 DTI 36
MIP 149/ 60 TX 7 NC 6 PA 6 GA 5 OH 5

4.0/2017-Q2 GNIILMB WAC 4.39/ 26 LSZ 96 3.7B/ 1.9B
LTV 95/ 94/ 63 FICO 673 REFI 19/ 8 JMB 0 FT 69
PENNY 17 LAKEV 16 NSTAR 10 OTHER 10 QUICK 7 FREE 7

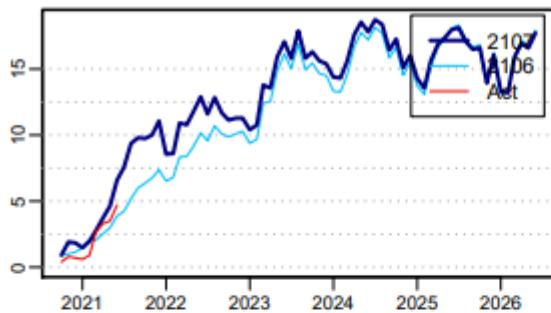


FHA 69 VA 10 RH 19 PLM 0 HARP 0 DTI 38
MIP 141/ 64 OH 9 TX 9 IN 7 MI 7 GA 5

- More seasoned loan balance GNMAAs have posted relatively high speeds, supported by strong HPA and refinances into conventional loans.
- Buyouts are quite significant on most seasoned GNMA customs as well, generally ranging from mid single digits to over 20 CDR recently, and with 5-10% 120+ DQs still remaining in the pools.

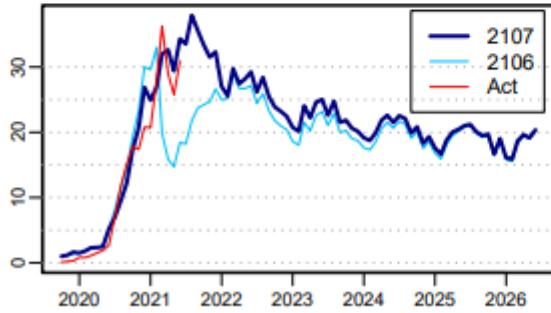
RH Voluntaries Generally Well Captured by v21.7

2.5/2020-Q3 GNIIRH WAC 2.91/-30 LSZ 215 5.8B/ 5.6B
LTV 100/ 100/ 85 FICO 708 REFI 8/ 0 JMB 0 FT 71
PENNY 33 OTHER 25 LAKEV 6 FREE 6 GUILD 3 MOVEM 3



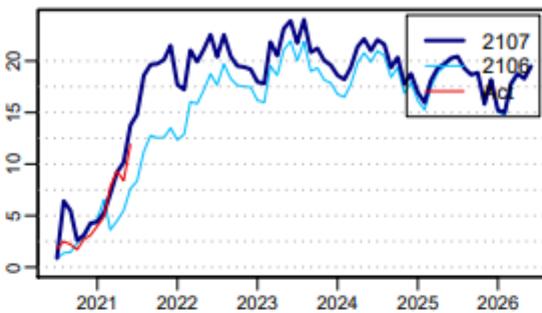
FHA 0 VA 0 RH 99 PLM 0 HARP 0 DTI 36
MIP 100/ 35 NC 6 TN 6 LA 5 TX 5 FL 4

3.5/2019-Q4 GNIIRH WAC 3.95/ 8 LSZ 196 2.4B/ 1.8B
LTV 99/ 99/ 78 FICO 697 REFI 3/ 0 JMB 0 FT 80
PENNY 45 LAKEV 14 FREE 10 NSTAR 8 OTHER 7 CLBR 3



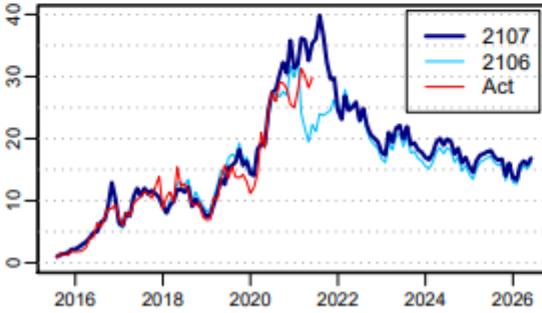
FHA 0 VA 0 RH 99 PLM 2 HARP 0 DTI 35
MIP 100/ 35 LA 6 FL 5 GA 5 NC 5 TN 5

3.0/2020-Q3 GNIIRH WAC 3.43/ -3 LSZ 202 3.9B/ 3.6B
LTV 100/ 100/ 83 FICO 699 REFI 7/ 0 JMB 0 FT 75
PENNY 39 OTHER 24 LAKEV 9 FREE 4 AMHOM 3 GUILD 3



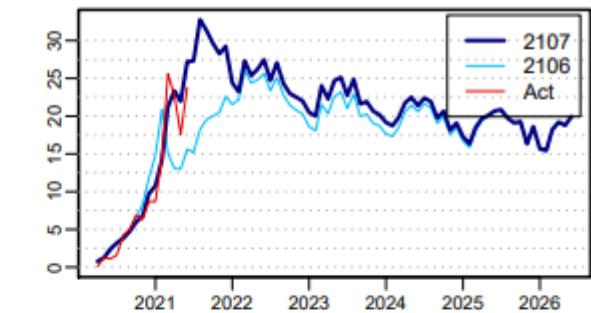
FHA 0 VA 0 RH 99 PLM 0 HARP 0 DTI 36
MIP 100/ 35 LA 7 NC 6 TN 6 GA 5 IN 5

3.5/2015-Q3 GNIIRH WAC 3.93/ -9 LSZ 169 2.4B/ 913MM
LTV 100/ 100/ 57 FICO 704 REFI 2/ 0 JMB 0 FT 80
LAKEV 96 USB 2 CARRG 1 WELLS 0 JPM 0 CITI 0



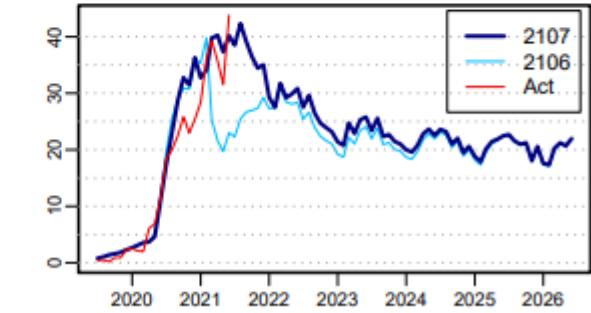
FHA 0 VA 1 RH 98 PLM 0 HARP 0 DTI 35
MIP 204/ 49 NC 8 LA 6 TN 6 GA 4 SC 4

3.5/2020-Q2 GNIIRH WAC 3.89/ 20 LSZ 186 1.5B/ 1.3B
LTV 99/ 99/ 81 FICO 688 REFI 4/ 0 JMB 0 FT 81
PENNY 39 LAKEV 18 OTHER 17 FREE 6 AMHOM 5 NSTAR 2



FHA 0 VA 0 RH 100 PLM 1 HARP 0 DTI 35
MIP 100/ 35 LA 8 IN 6 NC 6 FL 5 GA 5

4.0/2019-Q3 GNIIRH WAC 4.44/ 29 LSZ 186 1.9B/ 1.3B
LTV 100/ 100/ 77 FICO 686 REFI 0/ 0 JMB 0 FT 84
PENNY 41 NSTAR 19 LAKEV 10 FREE 8 OTHER 8 QUICK 3



FHA 0 VA 0 RH 99 PLM 1 HARP 0 DTI 36
MIP 100/ 35 GA 6 LA 6 FL 5 IN 5 MO 5

- RH collateral has recently been printing in line with voluntary projections on average, but buyouts so far have lagged behind model to some extent, particularly on Lakeview-dominated cohorts.
- Lakeview does not appear to be nearly as aggressive with RH buyouts as with FHA. However, the remaining high DQs seem eventually more likely than not to come out of the pools.

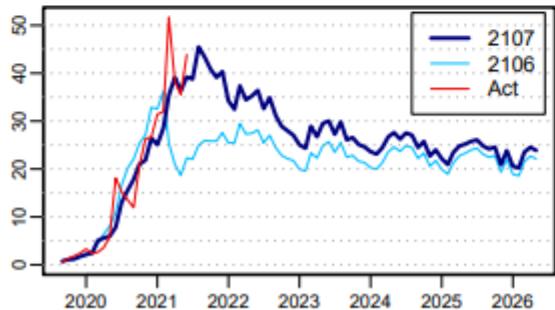
G2 HFA Projections Faster in v21.7, But Maybe Not Enough

3.0/2020 HFA WAC 3.49/ 10 LSZ 244 5.7B/ 5.7B
LTV 101/ 98/ 86 FICO 684 REFI 0/ 0 JMB 0 FT 92
HFAGY 35 USB 29 LAKEV 21 GTWAY 1 PENNY 1



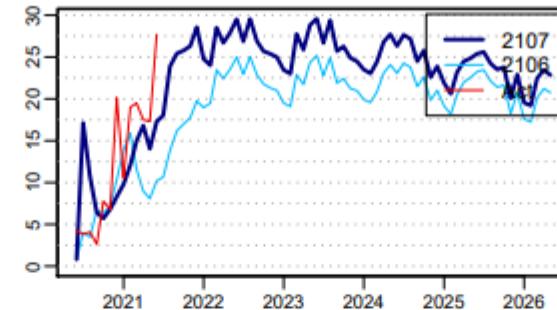
FHA 98 VA 0 RH 0 PLM 0 HARP 0 DTI 42 MB 36
MIP 173/ 84 TX 16 CO 11 MD 7 WA 7 CA 6

4.0/2019 HFA WAC 4.50/ 50 LSZ 232 2.6B/ 2.6B
LTV 101/ 98/ 80 FICO 671 REFI 1/ 0 JMB 0 FT 91
HFAGY 44 LAKEV 29 USB 10 GTWAY 6 FSTAR 1



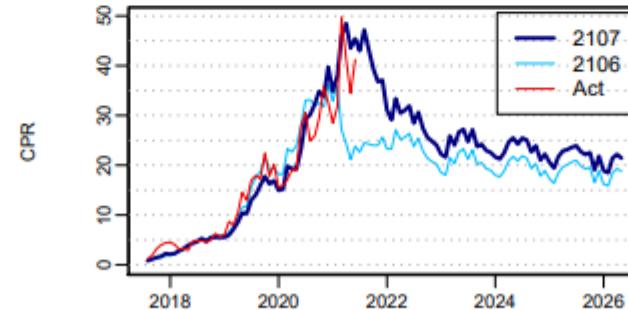
FHA 98 VA 0 RH 0 PLM 0 HARP 0 DTI 44 MB 37
MIP 174/ 84 TX 16 CO 15 WA 8 CA 7 VA 6

3.5/2020 HFA WAC 3.95/ 48 LSZ 241 4.0B/ 4.0B
LTV 102/ 98/ 85 FICO 676 REFI 0/ 0 JMB 0 FT 90
HFAGY 43 LAKEV 22 USB 14 GTWAY 2 PENNY 1



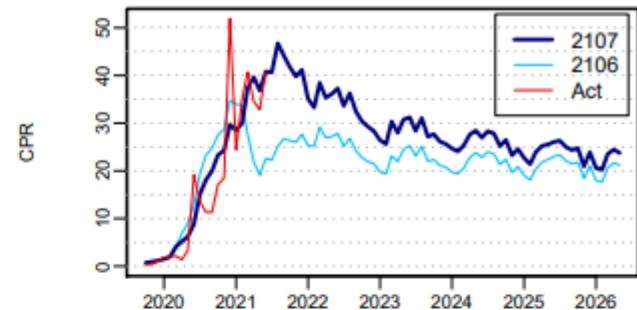
FHA 98 VA 0 RH 0 PLM 0 HARP 0 DTI 43 MB 37
MIP 174/ 84 TX 21 WA 9 AZ 8 CO 7 CA 6

4.0/2017 HFA WAC 4.41/ 30 LSZ 187 2.1B/ 2.1B
LTV 101/ 98/ 68 FICO 678 REFI 0/ 0 JMB 0 FT 91
HFAGY 45 LAKEV 38 USB 12 FSTAR 1 MDFST 1



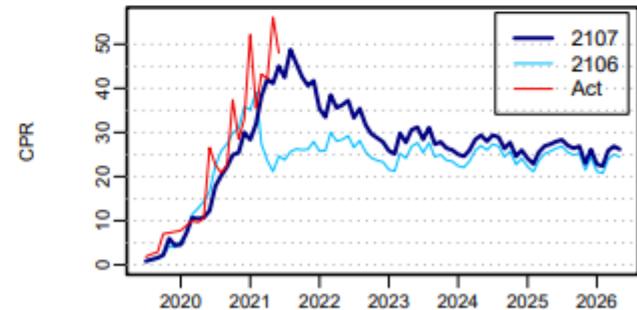
FHA 98 VA 0 RH 0 PLM 0 HARP 0 DTI 42 MB 31
MIP 174/ 84 TX 22 CA 7 CO 6 KY 5 UT 5

3.5/2019 HFA WAC 4.04/ 15 LSZ 253 2.0B/ 2.0B
LTV 102/ 98/ 80 FICO 678 REFI 0/ 0 JMB 0 FT 93
LAKEV 43 HFAGY 33 USB 14 GTWAY 4 PENNY 2



FHA 97 VA 0 RH 1 PLM 0 HARP 0 DTI 42 MB 39
MIP 173/ 84 CA 23 WA 10 VA 9 TX 7 IL 5

4.5/2019 HFA WAC 5.00/ 77 LSZ 230 2.8B/ 2.8B
LTV 101/ 98/ 80 FICO 668 REFI 0/ 0 JMB 0 FT 92
HFAGY 46 LAKEV 31 USB 10 NSTAR 4 GTWAY 3



FHA 99 VA 0 RH 0 PLM 0 HARP 0 DTI 44 MB 37
MIP 174/ 85 TX 20 CO 17 WA 7 AZ 4 FL 4

- Prepayments for GNMA II HFA collateral (in the aggregate) have responded sharply to the rally, likely supported by very strong HPA. Model v21.7 has generally been slow on voluntaries in recent months.
- HFA prepayments may vary significantly by geography and originator/servicer; specific adjustments for selected individual state HFAs had been targeted for v21.7, but will be delayed to v21.8.

COVID IMPACT UPDATES FOR MODEL VERSION 21.7

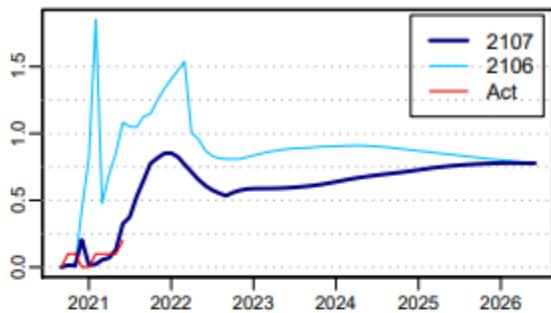
Residual COVID-19 Impact – Policy Driven Model Changes

Model v21.7 incorporates latest FHFA/GSE and HUD/GNMA policies regarding forbearance, loss mitigation, and buyouts, as well as certain new disclosures:

Announcement / Disclosure	Model Impact
Forbearance is generally permitted for up to 18 months from initial request date, with shorter periods in some cases for those requesting it later in the crisis.	Model builds in a longer potential forbearance timeline than in the original v21.6 release, which was based on the 12 months granted in the CARES Act. Note that model changes were made earlier this year to extend the maximum forbearance timeline in v21.6.
FHFA directs GSEs to change buyout trigger from 120 days to 24 months of delinquency, subject to key exceptions, effective in 2021	Under the key exceptions (permanent modification, short sale, deed-in-lieu, or referral to foreclosure), most delinquent loans will be repurchased well before 24 months unless disaster forbearance is in effect. For loans not in forbearance, the model delays buyouts 3-6 months versus the previous 120-day policy.
FHFA adjusts Flex Modification terms for COVID-19 hardships, allowing rate reductions for borrowers with mark-to-market LTVs below 80%.	This policy change, or something similar, was largely anticipated in the prior production model (v21.6). We do assume slightly lower "cure" rates (i.e., reinstatement, repayment plan or payment deferral, which do not result in GSE buyouts of the loans) in v21.7 versus v21.6. The delinquent population has suffered some deterioration in quality as better positioned borrowers have exited forbearance (largely via payment deferrals) over the past several months.
HUD announces Advance Loan Modification (ALM) for delinquent FHA borrowers as a pre-waterfall option to facilitate resolution of FHA loans remaining in forbearance. Also simplifies waterfall to two options (first step similar to previous COVID-19 partial claim).	A buyout is permitted but not required to complete an FHA COVID-19 partial claim (now referred to as COVID-19 Recovery Standalone Partial Claim, and permits a maximum of a 25% partial claim, rather than 30%). But with ALM available to borrowers as a pre-waterfall step (for those that can attain a 25% payment reduction from a rate-and-term mod to 360 months and PMMS mortgage rate; servicers must mail docs to borrowers and mod is effective upon return of signed docs), as well as the lower quality of FHA borrowers still delinquent, we assume that only a small fraction (well under 25%) of such borrowers will resume contractual payments such that buyouts are not mandatory.
VA and RH update their loss mitigation waterfalls on July 23, 2021 to implement further COVID relief measures.	The updated VA waterfall continues to prioritize repayment plans, and effective on July 27, a COVID-19 VAPCP (similar to FHA's COVID standalone partial claim option) becomes available. The RH program managed by USDA continues to provide for a mortgage recovery advance as one of the first-priority resolution options. In contrast to FHA, there is no pre-waterfall modification option for VA or RH borrowers. In light of this and the better credit of VA and RH borrowers vs. FHA, we assume that 30-50% of VA and RH borrowers will be able to cure, such that buyouts are not mandatory.
GNMA and the GSEs provide disclosures to calculate and/or estimate the size and timing of payment deferrals.	Because a payment deferral is a second lien that bears no interest and is not due until the payoff of the first lien, it generally creates a disincentive to refinance the loan (although FHA-to-FHA refinances allow resubordination of the HUD second lien created for the deferral). Model version 21.7 incorporates this disincentive for the deferred portions of existing pools, as well as for new issuance (like RG and I5/I6 pools) that consists primarily or entirely of loans with payment deferrals.

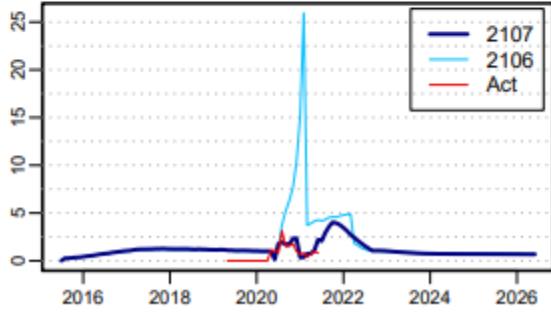
Conventional Buyout Model Updated per New FHFA Policies

2.5/2020-Q3 FN30FICO WAC 3.44/ 18 LSZ 381 17.4B/ 15.1B
LTV 78/ 77/ 64 FICO 676 REFI 58/ 22 JMB 6 FT 19
OTHER 50 QUICK 7 LAKEV 6 MTRX 4 PENNY 3 USB 3



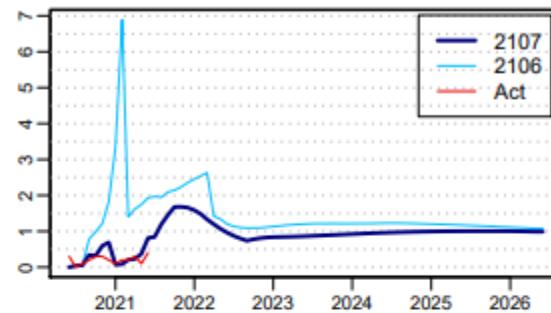
BRO 13 COR 16 RET 71 INV 0 2ND 2 HARP 0 DTI 37
PMI 35/ 9 HR 0 PT NA CA 25 TX 6 WA 6 AZ 5 CO 5

4.0/2015-Q3 FN30FICO WAC 4.65/ 64 LSZ 290 15.7B/ 3.4B
LTV 80/ 79/ 44 FICO 671 REFI 63/ 24 JMB 1 FT 15
NWRES 20 OTHER 15 WELLS 10 JPM 6 QUICK 5 NSTAR 5



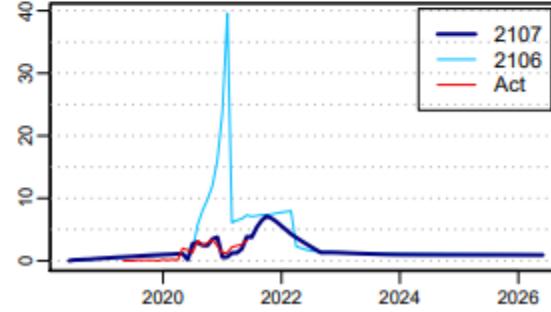
BRO 9 COR 26 RET 65 INV 15 2ND 3 HARP 0 DTI 38
PMI 20/ 5 HR 0 PT NA CA 21 TX 10 FL 7 IL 4 NJ 4

3.0/2020-Q2 FN30FICO WAC 3.91/ 45 LSZ 376 6.3B/ 4.6B
LTV 80/ 79/ 65 FICO 674 REFI 54/ 26 JMB 5 FT 22
OTHER 47 LAKEV 10 MTRX 5 QUICK 4 USB 3 PENNY 2



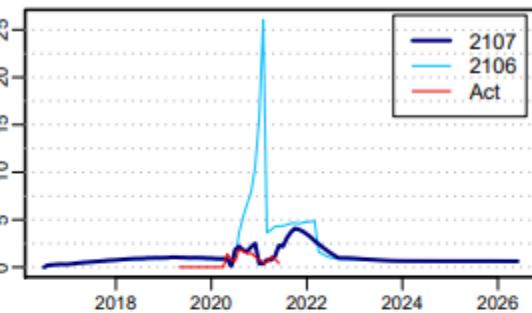
BRO 12 COR 20 RET 67 INV 0 2ND 2 HARP 0 DTI 38
PMI 37/ 10 HR 0 PT NA CA 23 TX 8 WA 6 AZ 4 CO 4

4.5/2018-Q2 FN30FICO WAC 5.19/ 68 LSZ 324 17.2B/ 5.0B
LTV 81/ 80/ 57 FICO 685 REFI 44/ 32 JMB 3 FT 28
WELLS 16 OTHER 14 NWRES 8 MTRX 7 PENNY 6 LAKEV 6



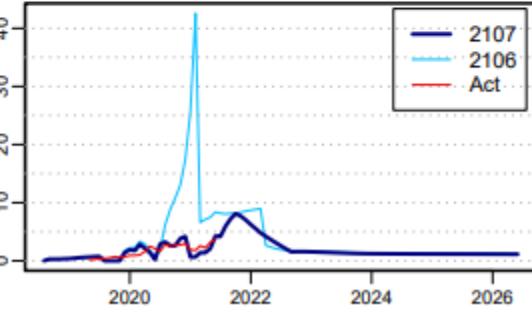
BRO 10 COR 38 RET 52 INV 11 2ND 3 HARP 0 DTI 41
PMI 33/ 8 HR 0 PT NA CA 21 FL 10 TX 10 CO 4 WA 4

3.5/2016-Q3 FN30FICO WAC 4.12/ 37 LSZ 319 9.7B/ 2.9B
LTV 79/ 78/ 46 FICO 672 REFI 51/ 21 JMB 2 FT 21
OTHER 19 WELLS 16 NWRES 13 PENNY 6 MTRX 6 LAKEV 6



BRO 9 COR 30 RET 61 INV 3 2ND 3 HARP 0 DTI 37
PMI 24/ 6 HR 0 PT NA CA 24 TX 10 FL 7 MA 4 NJ 4

5.0/2018-Q3 FN30FICO WAC 5.74/ 106 LSZ 280 11.4B/ 3.6B
LTV 82/ 81/ 59 FICO 684 REFI 47/ 41 JMB 1 FT 28
WELLS 21 OTHER 11 QUICK 10 LAKEV 9 PENNY 7 NWRES 6

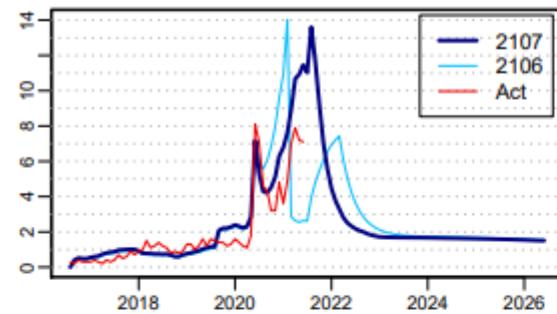


BRO 9 COR 45 RET 47 INV 20 2ND 2 HARP 0 DTI 40
PMI 33/ 8 HR 0 PT NA TX 17 CA 15 FL 12 AZ 5 NV 4

- Conventional buyouts have generally been very slow so far, with few rate-and-term modifications. Most loans exiting forbearance so far have been reinstated or have received payment deferrals. The FHFA long-term buyout policy change in 2021 sharply reduced low buyouts even further.
- While significant loan modifications seem inevitable once borrowers exhaust available forbearance, buyout levels are likely to be quite modest, even for weaker credit, in the context of very high voluntary speeds.

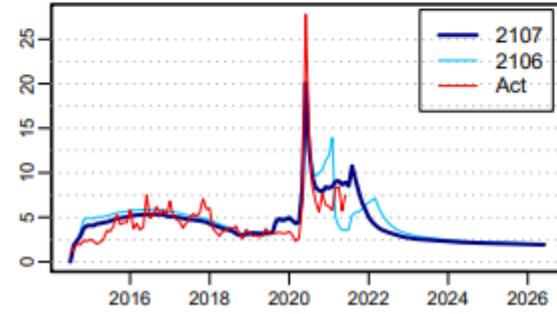
GNMA Buyouts Recalibrated By Servicer / Guarantor

3.0/2016-Q3 GNII WAC 3.41/-27 LSZ 278 219.3B/ 64.6B
 LTV 95/ 95/ 57 FICO 704 REFI 32/ 8 JMB 2 FT 43
 PENNY 16 LAKEV 15 FREE 14 OTHER 8 WELLS 7 USAA 5



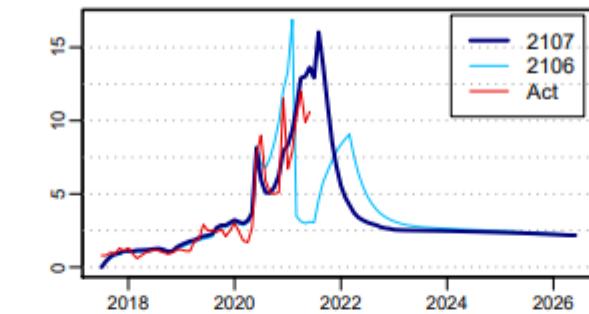
FHA 51 VA 41 RH 6 PLM 1 HARP 0 DTI 40
 MIP 127/ 46 CA 9 TX 8 FL 7 VA 6 GA 4

4.0/2014-Q2 GNII WAC 4.35/-0 LSZ 226 124.4B/ 18.0B
 LTV 94/ 94/ 49 FICO 673 REFI 20/ 3 JMB 0 FT 43
 WELLS 21 LAKEV 12 PENNY 10 FREE 10 CARRG 6 OTHER 6



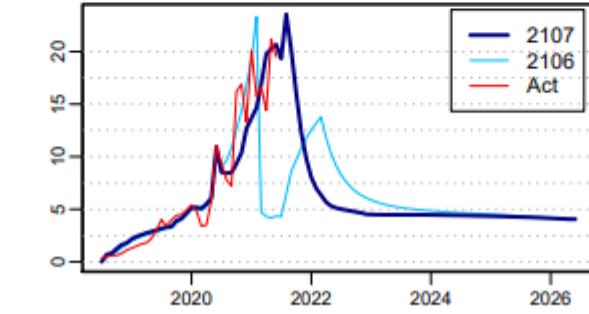
FHA 66 VA 18 RH 14 PLM 19 HARP 0 DTI 39
 MIP 133/ 73 TX 10 FL 7 CA 6 NY 6 GA 4

3.5/2017-Q3 GNII WAC 3.90/-21 LSZ 272 211.3B/ 64.9B
 LTV 95/ 95/ 63 FICO 693 REFI 23/ 11 JMB 1 FT 52
 PENNY 15 FREE 13 LAKEV 12 OTHER 8 QUICK 5 NSTAR 5



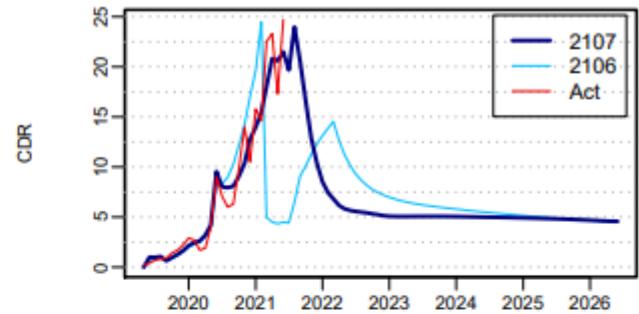
FHA 60 VA 31 RH 8 PLM 3 HARP 0 DTI 41
 MIP 129/ 53 CA 8 FL 8 TX 8 VA 5 GA 4

4.5/2018-Q3 GNII WAC 4.94/ 30 LSZ 257 105.5B/ 27.5B
 LTV 97/ 96/ 70 FICO 666 REFI 12/ 9 JMB 1 FT 66
 LAKEV 16 FREE 12 OTHER 12 PENNY 11 NSTAR 7 WELLS 4



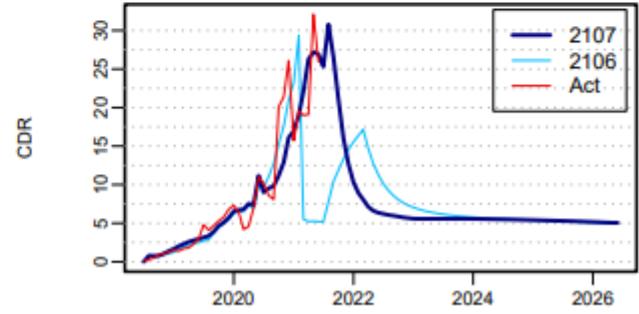
FHA 72 VA 17 RH 10 PLM 5 HARP 0 DTI 43
 MIP 143/ 64 FL 10 TX 10 CA 7 GA 5 NY 4

4.0/2019-Q2 GNII WAC 4.49/ 38 LSZ 272 112.2B/ 40.9B
 LTV 96/ 96/ 74 FICO 659 REFI 17/ 9 JMB 1 FT 56
 OTHER 14 LAKEV 13 PENNY 12 FREE 9 NSTAR 6 QUICK 4



FHA 72 VA 19 RH 8 PLM 10 HARP 0 DTI 43
 MIP 142/ 63 TX 11 FL 10 CA 7 GA 5 NY 4

5.0/2018-Q3 GNII WAC 5.47/ 79 LSZ 238 44.4B/ 12.0B
 LTV 97/ 96/ 70 FICO 646 REFI 10/ 8 JMB 0 FT 74
 LAKEV 18 OTHER 15 FREE 10 NSTAR 9 PENNY 8 HFAGY 8

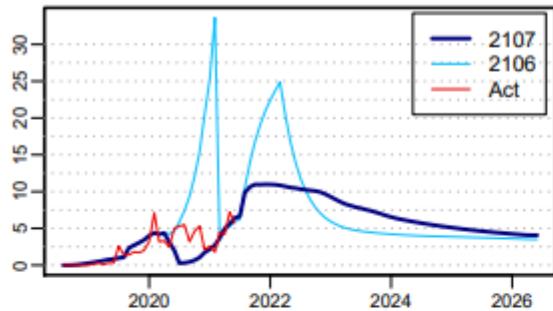


FHA 80 VA 13 RH 6 PLM 1 HARP 1 DTI 43
 MIP 151/ 69 TX 15 FL 10 CA 7 GA 4 IL 4

- In general, the updated buyout model pulls future GNMA buyouts forward, as we project more buyouts from non-bank servicers, driven by liquidity and the economics of RG pool issuance, as well as likely uptake of the more streamlined and simpler FHA mod options made available recently.
- The ultimate level and timing of GNMA buyouts remains highly speculative.

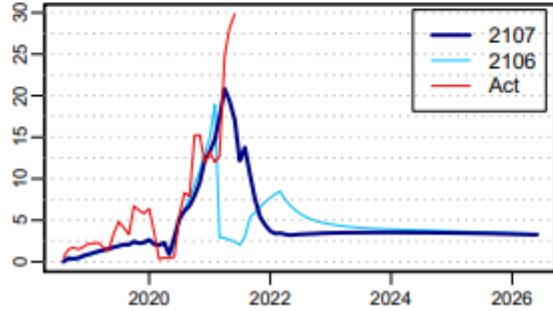
Buyout Differences by Servicer Captured (Albeit Imperfectly)

4.5/2018-Q3 GNII30FREE WAC 4.96/ 31 LSZ 212 2.0B/ 598MM
 LTV 97/ 97/ 71 FICO 661 REFI 11/ 9 JMB 1 FT 69
 FREE 100 WELLS 0 JPM 0 CITI 0 BOACW 0 QUICK 0



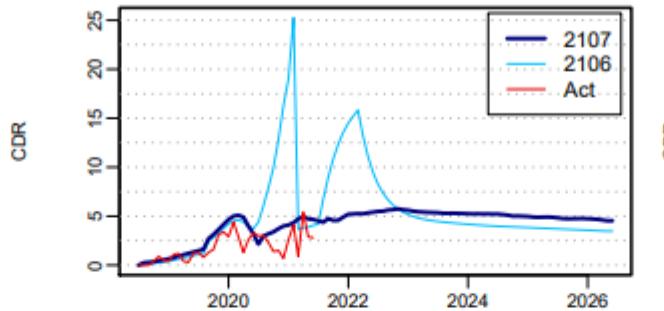
FHA 54 VA 18 RH 25 PLM 6 HARP 0 DTI 40
 MIP 131/ 55 FL 10 NY 9 TX 9 OK 5 PA 5

4.5/2018-Q3 GNII30PENNY WAC 4.88/ 26 LSZ 150 4.4B/ 1.8B
 LTV 98/ 97/ 71 FICO 687 REFI 6/ 5 JMB 0 FT 82
 PENNY 100 WELLS 0 JPM 0 CITI 0 BOACW 0 QUICK 0



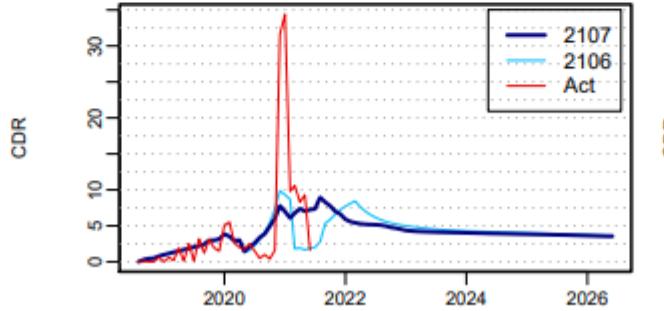
FHA 52 VA 17 RH 30 PLM 0 HARP 0 DTI 40
 MIP 130/ 55 FL 8 TX 8 GA 7 NY 5 NC 5

4.5/2018-Q3 GNII30HFAGY WAC 5.01/ 43 LSZ 211 1.6B/ 856MI
 LTV 102/ 98/ 70 FICO 671 REFI 0/ 0 JMB 0 FT 96
 HFAGY 100 WELLS 0 JPM 0 CITI 0 BOACW 0 QUICK 0



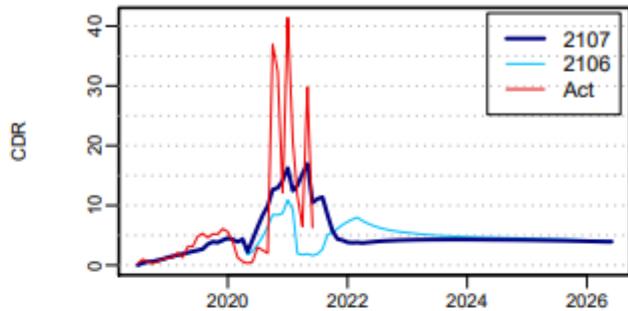
FHA 97 VA 0 RH 2 PLM 0 HARP 0 DTI 44
 MIP 172/ 83 CO 28 VA 17 MO 11 TX 10 UT 8

4.5/2018-Q3 GNII30QUICK WAC 4.95/ 32 LSZ 104 1.1B/ 459MI
 LTV 89/ 89/ 65 FICO 667 REFI 45/ 38 JMB 0 FT 48
 QUICK 100 WELLS 0 JPM 0 CITI 0 BOACW 0 PROVI 0



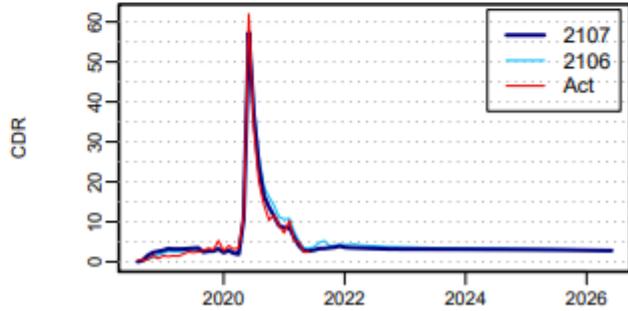
FHA 82 VA 9 RH 7 PLM 0 HARP 0 DTI 38
 MIP 156/ 70 OH 10 MI 9 PA 7 GA 6 NY 6

4.5/2018-Q3 GNII30LAKEV WAC 4.97/ 38 LSZ 186 5.2B/ 1.9B
 LTV 97/ 96/ 70 FICO 673 REFI 8/ 5 JMB 0 FT 76
 LAKEV 100 WELLS 0 JPM 0 CITI 0 BOACW 0 QUICK 0



FHA 81 VA 4 RH 13 PLM 0 HARP 0 DTI 42
 MIP 158/ 73 TX 12 CA 9 FL 9 GA 6 WA 6

4.5/2018-Q3 GNII30WELLS WAC 4.92/ 25 LSZ 139 1.4B/ 579M
 LTV 98/ 97/ 71 FICO 715 REFI 6/ 5 JMB 0 FT 75
 WELLS 100 JPM 0 CITI 0 BOACW 0 QUICK 0 PROVI 0



FHA 64 VA 20 RH 15 PLM 2 HARP 0 DTI 41
 MIP 137/ 59 TX 14 PA 7 FL 6 GA 6 OH 6

- Model v21.6 captured immediate buyouts from banks, but little else. Model version 21.7 is somewhat better at matching servicer level differences so far, although buyout patterns from most non-banks have been very noisy.
- Additional changes may be needed in future experimental models, since the ultimate resolution of remaining delinquencies remains uncertain.

Buyout Model Note – Overall and D120+ Distributions Differ

- For GNMA, the servicer and guarantor are important determinants of expected buyouts, particularly in the current COVID-19 affected environment.
- The prepayment model computes weighted average buyouts based on the guarantor and servicer distributions of the overall pool, not the distributions of the delinquent portion. This would be difficult to remediate, given the amount of additional data that the model would need to consume.
- The buyout projections should therefore be viewed with caution when delinquencies are high and when the servicer and guarantor distributions on the delinquent portion differ significantly from the distributions on the overall pool.
- To illustrate, the GNMA overall universe distributions and the 120+ day delinquent universe distributions are compared below (as of July factor date). As might be expected given buyout patterns so far, the servicer distribution is significantly different (most notably, Freedom is 25% of the 120+ delinquent population but only 11% of total outstanding, and Wells Fargo/US Bank are largely absent from D120+ despite making up more than 10% of total outstanding). The guarantor distribution is relatively close, with stronger FHA buyouts offsetting higher FHA delinquency rates.

Guarantor Breakdown

GNMA	FHA	VA	RH
Universe	58%	36%	6%

Top 10 Servicer Breakdown

Other	Lakeview	Pennymac	Freedom	Wells Fargo	Nationstar	Quicken	New Resi	US Bank	Carriington
39%	11%	11%	11%	8%	5%	4%	3%	3%	2%

GNMA	FHA	VA	RH
D120+	63%	30%	7%

Other	Freedom	Lakeview	Pennymac	Nationstar	New Resi	Quicken	Caliber	USAA	UWM
27%	25%	13%	12%	9%	4%	3%	3%	2%	2%

Significant Issuance of RG Expected; Model Fits Vary So Far

RG Cohort (shown if 200mm+ in size)	Curr Bal (\$mm)	Act 3m CPR	Proj 3m CPR	Act/Prj Ratio
3s of 2019	236	38	34.1	1.14
3s of 2016	317	39.9	27.2	1.59
3s of 2015	373	35.6	26.8	1.40
3s of 2013	404	20	13.1	1.58
3.5s of 2018	478	37.6	37.9	0.99
3.5s of 2017	292	38.5	33.9	1.17
3.5s of 2016	535	37.2	31	1.25
3.5s of 2015	612	37	29.6	1.31
3.5s of 2012	600	22.6	15.1	1.56
4s of 2018	545	32.8	38.4	0.82
4s of 2017	255	31.6	35.8	0.86
4s of 2014	210	26.9	28.6	0.93
4.5s of 2018	333	37.8	38.5	0.98
4.5s of 2010	255	26.7	26	1.03
Aggregate (including cohorts not shown)	7,003	32.7	29.8	1.10

- Model version 21.7 generally captures the limited prepayment history in aggregate, but with some significant variation by cohort so far (model quite slow on 3s, somewhat slow on 3.5s, fast on 4s, about right on 4.5s; fits better on new collateral as compared to seasoned collateral).
- Model is based on behavior of 6m clean pay reperformers pre-COVID, but with lower assumed borrower impairment. Deferred principal is accounted for (in terms of the disincentive if a first lien payoff requires the deferred principal to be repaid or included in the new loan). Note that HUD second liens from FHA deferrals may be re-subordinated in a FHA-to-FHA refinance.

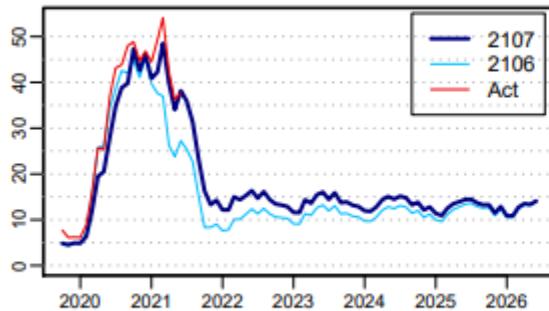
Highest HPA Since World War II; Model +17% 2021, 3% After

- Housing expected to post six quarters of 15%+ annualized growth starting back in Q3 2020, even after many years of appreciation previously.
- The COVID-19 crisis has changed the demand dynamics for housing; while likely temporary in many respects, there may be a partially permanent shift away from high-priced, congested urban areas.
- Historical patterns and recent trends seem to indicate that the housing market will return to low single digit appreciation rates by 2022.
- The model baseline is +20% Q2, +20% Q3, +12.5% Q4, and +3% thereafter, translating to about +9.5% for the 12 months starting in July 2021, and +3% annually thereafter.
- Model version 21.7 builds in a downside HPA scenario for 25% of the stochastic rate paths of about flat for the next 12 months, followed by -5% annually for two years and again flat in the fourth year, before returning to normalized 3% annual growth.
- The upside scenario (also applicable on 25% of the stochastic rate paths) is the same as baseline for the first year, but assumes +5% HPA in the second year and +4% in the third year before returning to normalized 3% annual growth.
- These scenarios imply an assumption that the housing market is neither overvalued or undervalued as of Q2 2021 (i.e., that average appreciation across scenarios is +3% annually starting in July 2021).
- As for model version 21.6, no correlation is assumed between interest rates and HPA.
- For a thorough analysis of the housing market, please see Robert Young's recent presentation (<https://www.citivelocity.com/t/eppublic/27mzF>), and his ongoing updates posted to CitiVelocity.

Strong Cash-Outs Expected From HPA Surge in a Backup

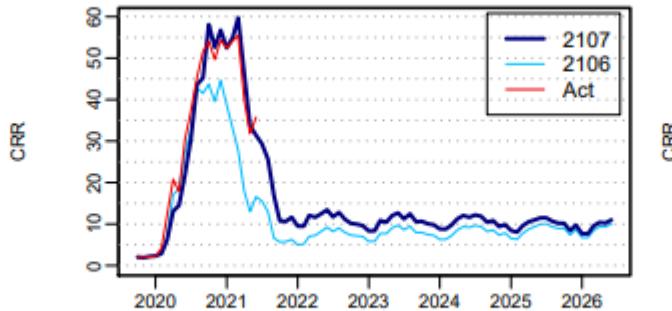
Voluntary Prepayment Projections After Immediate 100 bps Rate Backup

2.5/2019-Q4 FN15DLV WAC 3.14/-18 LSZ 340 21.1B/ 9.2B
LTV 66/ 66/ 46 FICO 764 REFI 78/ 19 JMB 1 FT 6
OTHER 26 WELLS 9 QUICK 8 NWRES 7 JPM 4 MTRX 4



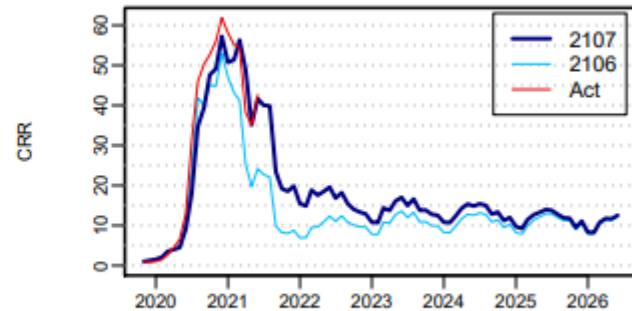
BRO 11 COR 21 RET 68 INV 0 2ND 6 HARP 0 DTI 32
PMI 6/ 1 HR 0 PT NA CA 14 TX 9 FL 6 NJ 4 PA 4

2.5/2019-Q4 FN30DLV WAC 3.49/-32 LSZ 379 41.8B/ 19.4B
LTV 74/ 74/ 57 FICO 766 REFI 57/ 12 JMB 4 FT 16
OTHER 20 WELLS 13 PENNY 12 NWRES 10 PINGR 6 QUICK 5



BRO 14 COR 39 RET 47 INV 0 2ND 4 HARP 0 DTI 34
PMI 28/ 7 HR 0 PT NA CA 19 TX 7 FL 5 WA 5 CO 4

2.5/2019-Q4 GNIIMULTI WAC 3.04/-74 LSZ 347 17.3B/ 7.8B
LTV 92/ 92/ 71 FICO 723 REFI 54/ 11 JMB 3 FT 27
PENNY 15 QUICK 11 LAKEV 10 NWRES 8 OTHER 8 USHOR 7



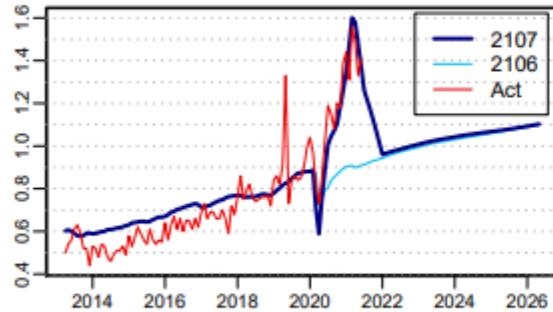
FHA 34 VA 62 RH 3 PLM 0 HARP 0 DTI 40
MIP 94/ 29 CA 15 FL 10 TX 9 VA 5 CO 4

- As in 2017 and 2018, a rate backup in the present environment would free up significant capacity into strong HPA, driving servicer solicitations for cash-out refinancings.
- In the present environment, HPA is even stronger, and unemployment is expected to continue falling to below 2017-2018 levels with strong wage growth supporting higher payments required for a cash-out.
- While the curve would be steeper than in 2017 and 2018 if long-term rates back up without immediate Fed rate increases (in which case low bank prime rates might drive some borrowers into HELOCs instead), cash-out refinancings should still make up a very significant portion of baseline speeds in a rate backup, all else being equal.

Stimulus and Savings Leads to Elevated Curtailments

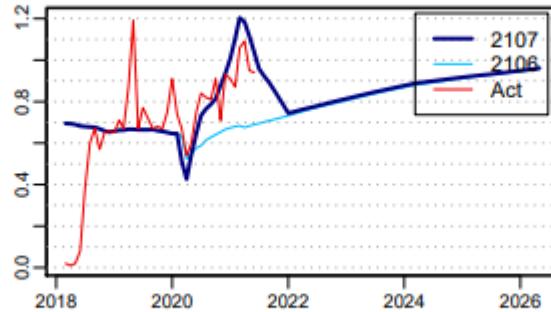
Conventional Generic Cohorts

3.0/2013 GEN WAC 3.57/-7 LSZ 291 35.2B/ 35.2B
LTV 73/ 71/ 34 FICO 764 REFI 68/ 17 JMB 2 FT 10
WELLS 19 JPM 10 TRUIS 10 USB 10 NWRES 7



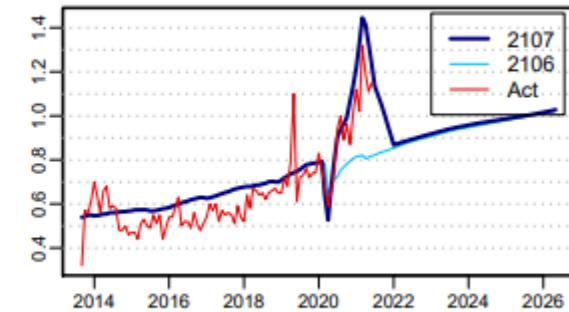
BRO 10 COR 38 RET 53 INV 3 2ND 4 HARP 0 DTI 32 MB 60
PMI 4/ 1 HR 0 PT 70/ 6/ 24 CA 19 NY 6 MA 5 VA 5 FL 4

3.5/2018 GEN WAC 4.16/-9 LSZ 325 12.6B/ 12.6B
LTV 77/ 77/ 55 FICO 755 REFI 29/ 14 JMB 2 FT 31
JPM 16 WELLS 14 MTRX 6 NWRES 6 QUICK 5



BRO 9 COR 37 RET 54 INV 2 2ND 5 HARP 0 DTI 36 MB 47
PMI 33/ 8 HR 0 PT 60/ 8/ 31 CA 13 TX 9 FL 8 NY 6 IL 4

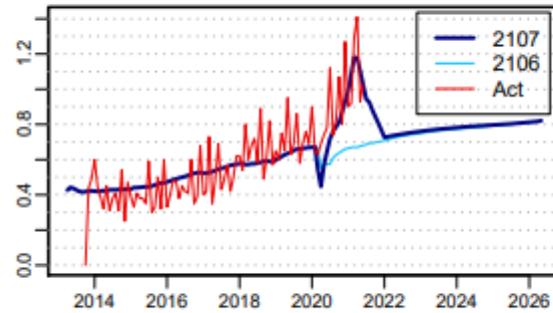
4.0/2013 GEN WAC 4.57/ 22 LSZ 262 9.2B/ 9.2B
LTV 79/ 77/ 40 FICO 738 REFI 57/ 14 JMB 0 FT 15
JPM 15 WELLS 11 NWRES 9 BOACW 8 NSTAR 8



BRO 8 COR 26 RET 66 INV 15 2ND 4 HARP 0 DTI 35 MB 49
PMI 12/ 4 HR 0 PT 71/ 8/ 20 CA 15 NY 7 FL 6 TX 6 IL 4

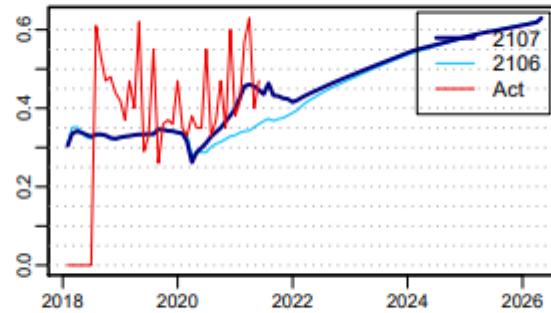
GNMA Generic Cohorts

3.0/2013 GEN WAC 3.33/-35 LSZ 255 26.8B/ 26.8B
LTV 94/ 94/ 46 FICO 718 REFI 44/ 5 JMB 2 FT 30
WELLS 28 PENNY 11 CARRG 10 LAKEV 10 FREE 5



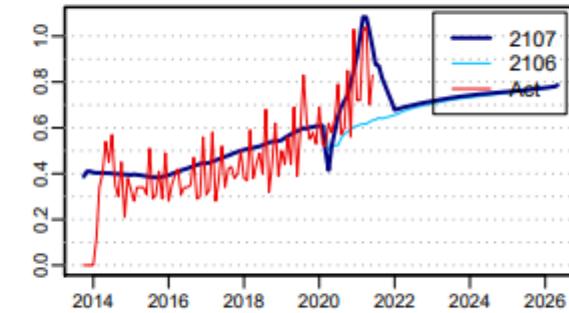
FHA 54 VA 37 RH 8 PLM 3 HARP 0 DTI 37 MB 49
MIP 115/ 64 CA 8 TX 7 VA 7 FL 5 MD 5

3.5/2018 GEN WAC 3.95/-33 LSZ 287 18.0B/ 18.0B
LTV 95/ 95/ 69 FICO 691 REFI 24/ 13 JMB 1 FT 41
LAKEV 13 PENNY 12 FREE 10 NAVY 8 WELLS 6



FHA 56 VA 35 RH 7 PLM 15 HARP 0 DTI 41 MB 43
MIP 120/ 49 FL 11 CA 8 TX 8 VA 5 GA 4

4.0/2013 GEN WAC 4.37/-12 LSZ 240 6.6B/ 6.6B
LTV 95/ 95/ 50 FICO 691 REFI 24/ 4 JMB 0 FT 48
WELLS 24 PENNY 14 LAKEV 13 FREE 5 CARRG 4



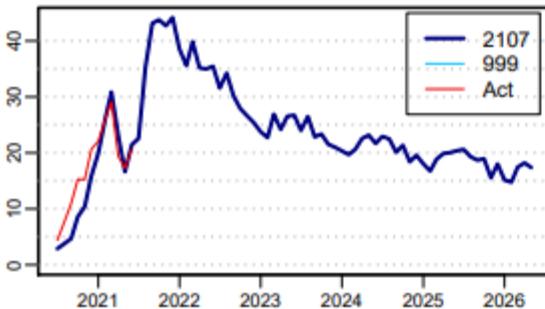
FHA 60 VA 23 RH 15 PLM 5 HARP 0 DTI 38 MB 41
MIP 126/ 73 TX 11 CA 6 FL 6 NY 5 GA 4

- Elevated curtailments driven by stimulus income and stronger inclination of borrowers to save (including by paying down debt) during pandemic; normalization assumed by about year-end 2021.

OTHER UPDATES TO MODEL VERSION 21.7

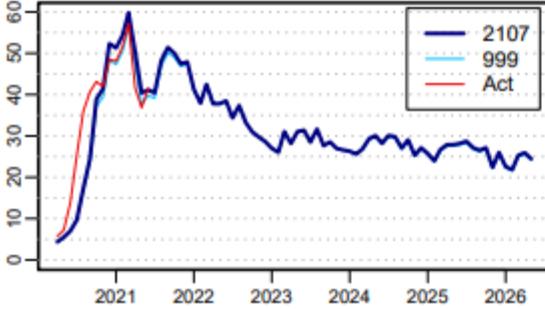
Adjustments Added For GSE PIW Disclosures in v21.7

2.5/2020 APPRAISAL WAC 3.40/ -2 LSZ 349 137.3B/ 137.3B
 LTV 78/ 78/ 68 FICO 753 REFI 53/ 22 JMB 5 FT 20
 WELLS 6 USB 5 CLBR 4 JPM 4 QUICK 4



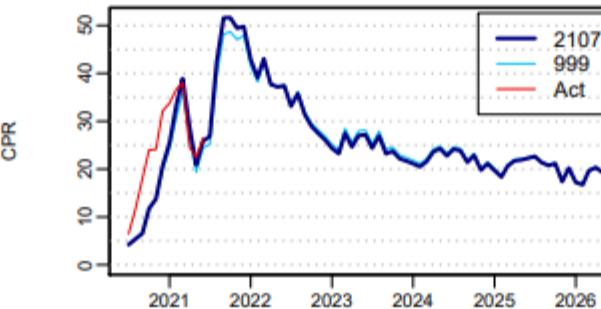
BRO 12 COR 29 RET 59 INV 8 2ND 4 HARP 0 DTI 35 MB 50
 PMI 38/ 10 HR 0 PT 62/ 8/ 30 CA 15 TX 7 FL 6 NY 4 WA 4

3.0/2020 WAIVER WAC 3.81/ 19 LSZ 323 8.9B/ 8.9B
 LTV 70/ 70/ 60 FICO 736 REFI 84/ 10 JMB 3 FT 5
 QUICK 16 USHOR 8 WELLS 8 CLBR 4 FREE 4



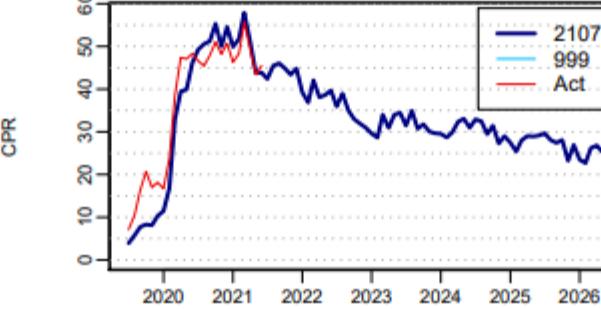
BRO 13 COR 24 RET 63 INV 0 2ND 3 HARP 0 DTI 35 MB 47
 PMI 6/ 1 HR 0 PT 64/ 7/ 28 CA 18 FL 7 AZ 6 WA 6 CO 4

2.5/2020 WAIVER WAC 3.35/ -5 LSZ 345 67.6B/ 67.6B
 LTV 70/ 70/ 60 FICO 754 REFI 92/ 14 JMB 4 FT 2
 QUICK 10 WELLS 6 USHOR 5 CLBR 4 MTRX 4



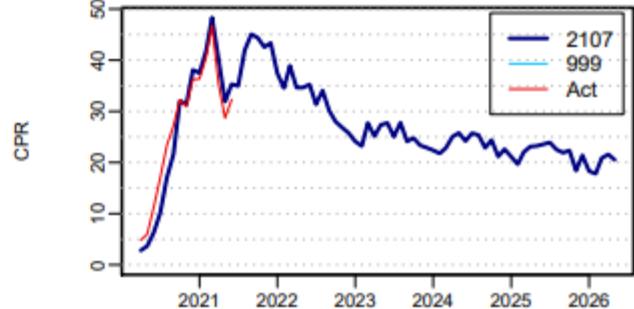
BRO 13 COR 20 RET 68 INV 0 2ND 3 HARP 0 DTI 33 MB 51
 PMI 11/ 2 HR 0 PT 65/ 7/ 29 CA 20 WA 6 AZ 5 CO 5 FL 5

3.5/2019 APPRAISAL WAC 4.35/ 21 LSZ 318 31.7B/ 31.7B
 LTV 81/ 81/ 65 FICO 742 REFI 30/ 19 JMB 2 FT 33
 JPM 12 WELLS 11 NWRES 6 PINGR 5 QUICK 5



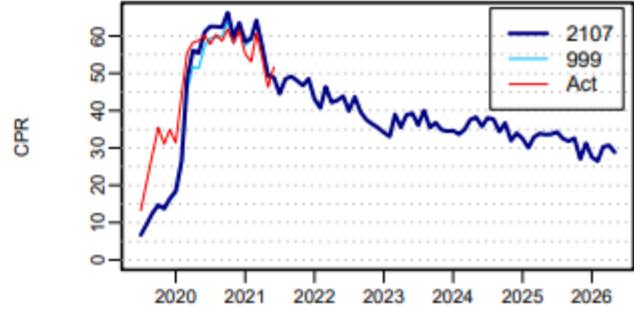
BRO 13 COR 39 RET 49 INV 5 2ND 5 HARP 0 DTI 37 MB 44
 PMI 46/ 12 HR 0 PT 63/ 9/ 27 CA 11 TX 9 FL 8 NY 7 IL 4

3.0/2020 APPRAISAL WAC 3.85/ 20 LSZ 320 50.1B/ 50.1B
 LTV 78/ 78/ 66 FICO 743 REFI 50/ 27 JMB 3 FT 22
 JPM 11 USB 7 WELLS 7 QUICK 5 CLBR 4



BRO 11 COR 36 RET 53 INV 12 2ND 4 HARP 0 DTI 36 MB 47
 PMI 36/ 9 HR 0 PT 63/ 9/ 27 CA 14 FL 8 TX 8 NY 5 WA 4

3.5/2019 WAIVER WAC 4.34/ 17 LSZ 334 1.9B/ 1.9B
 LTV 70/ 70/ 56 FICO 738 REFI 53/ 0 JMB 3 FT 14
 QUICK 16 NWRES 12 WELLS 10 USHOR 9 LAKEV 5



BRO 22 COR 28 RET 50 INV 0 2ND 6 HARP 0 DTI 37 MB 45
 PMI 0/ 0 HR 0 PT 61/ 9/ 30 CA 17 FL 9 AZ 5 CO 5 TX 5

- Plots show model v21.7 on FHLMC appraisal and waiver cohorts, versus a modification of v21.7 (v999) that removes the model adjustment for the property valuation method of the original loan (which the GSEs began to disclose in 2020). Model version 21.6 had no such adjustment.
- Collateral attributes of PIW and appraisal loans (LTV, servicer mix, geography, loan purpose) capture most of the speed differences between them, but efforts to produce comparable model performance on loans with or without initial PIW seems to indicate a relatively short-lived 2-3 CPR impact of the original property valuation method, all else being equal.

Servicer Refi Adjustment Changes: v21.7 vs. v21.6

Conventional*			GNMA*		
Slower	Similar	Faster	Slower	Similar	Faster
Bank of America	360 Mortgage	Midfirst Bank	FHLB Chicago	Amerihome*>	Impac
Chase (Retail)	American Financial	The Money Source	Freedom*>	Aurora Financial	Loan Depot*>
Citi	Amerihome	Mtg Rsrch (VA United)	Fremont	Citi	Matrix
Fifth Third (Retail)	Aurora Financial	Movement Mortgage	Guaranteed Rate	Colonial Savings	Midfirst Bank*<
M&T Bank	Banco Popular	MUFG Union Bank	Impact*>	Cornerstone Home	Mtg Rsrch (VA United)
PNC (Retail)	BOKF	Nationstar	Loan Depot	Fifth-Third	Movement Mortgage
USAA	Caliber	Nations Lending	Provident	MB Financial	Finance of America
US Bank (Retail)	Carrington	Navy Federal	Quicken (Rocket)*>	M&T Bank	First Guaranty
Umpqua Bank	Cenlar	New American	Sun West Mortgage	Navy Federal*<	Freedom*>
Truist (Retail)	Central Mtg (Arvest)	New Day Financial	SWBC Mortgage	PHH	Guaranteed Rate
Wells (Retail)	Chase (TPO)	New Residential		Plaza	Guild
	CIS Financial	Oceanside Lending		PNC	Homebridge
	Citizens Bank	Ocwen		SWBC Mortgage	Lakeview*>
	Colonial Savings	Pennymac		Truist	The Money Source*>
	Cornerstone Home	PHH		USAA*<	Nations Lending
	Everbank/TIAA	Pingora		USB	New American
	Fifth-Third (TPO)	Plaza		Umpqua Bank	New Day Financial
	Finance of America	PNC (TPO)		Wells Fargo*<	New Residential
	First Guaranty	Regions Bank			Oceanside Lending
	Flagstar	Select Porfolio Svcs			Pennymac*>
	Gateway Mortgage	Specialized Loan Svcs			Pingora
	Guild	Stearns			Quicken (Rocket)
	Homebridge	Truist (TPO)			Stearns
	Home Point Fin.	United Security			Sun West Mortgage*>
	Housing Fin Agy**	United Shore (UWM)			United Security
	Lakeview*>	US Bank (TPO)			Village Capital
	Matrix	Village Capital			
	MB Financial	Wells (TPO)			

* Applies only to fixed rate post-HARP collateral. ** Covers housing finance agencies in various states; HFA adjustments currently not differentiated by servicer

*> Cash-outs adjusted faster (independent of rate refis) *< Cash-outs adjusted slower (independent of rate refis)

Slower than v21.6

Faster than v21.6

Newly added

Glossary of Model Changes from v21.6 to v21.7

- * PIW effect/media effect/burnout recalibrated to better capture fast 2020 and 2021 speeds (through Jun) missed by prior model
- * Account for apparent burnout/media effect interaction: media effect accelerates burnout and is weaker on burned out collateral
- * Incorporate new GSE RefiNow/RefiPossible programs with cost reduction on estimated eligible low balance owner-occupied loans
- * Remove GSE adverse market refi fee consistent with FHFA announcement (Jul 16) terminating it as of August 2021
- * Recalibrate P/S spread model to increase the degree and length of impact driven by excess or tight capacity
- * Generally leads to wider levels in sharp rallies but lower levels when refinancible universe is depressed
- * Long term base GNMA rate spread to conventional assumed to be the average of 1/8 point and GN/FN swap (FN - GN CMM102)
- * Add overlay to investor property loans consistent with lender efforts to comply with new GSE high-risk loan limits
- * Short-term turnover adjusted upward given strong EHS prints over past several months, but also captures recent moderation
- * Short-term curtailments adjusted upward; conventional 30yr ran 50-75% above normal late 2020/early 2021 from stimulus payments
- * Adjust buyout timing assumptions for GSE and FHA/VA/RH loans given the additional forbearance and mod options made available
- * Recalibrate assumed roll rates and cure rates for GSE and FHA/VA/RH loans in forbearance based on latest available data
- * Recalibrate GNMA buyout model to better distinguish between servicers regarding buyouts on accumulated pipelines
- * Incorporate updated GSE buyout policy effective in 2021 (buy out upon mod or referral to foreclosure, or after 24 months)
- * Increase pace of non-bank buyouts of loans eligible only for RG pools, given strong RG payups and recent non-bank buyouts
- * Adjust voluntary/involuntary expectations for loans in RG pools to reduce impairment versus traditional reperforming GNMA loans
- * Adjust similarly for loans likely affected by COVID but repurchased prior to Jul 1, 2020 (when RG pooling rule took effect)
- * Account for impact of deferred principal on rate incentives for loans receiving partial claim or payment deferral
- * Introduce initial PIW as driver; recent PIW vs. non-PIW speed differences exceed expected attribute-driven differences
- * Account for streamline refis of FHA/VA COVID mods prior to normal eligibility at 7-8 WALA based on pre-COVID payment history
- * Adjust cashouts upward, driven by strong HPA; higher cashout rates evident in FHLMC data for Q4 2020 and likely continue in 2021
- * Historical FHFA purchase only HPA updated thru Q1 2021; base projection increased to 17% for 2021 and 3% for 2022 and beyond
- * Update future unemployment to Fed Mar 2021 projections (4.5% by Q4 2021, 3.9% by Q4 2022, 3.5% by Q4 2023, and 4.0% longer run)
- * Continue use of downside (average worst 25% outcomes) and upside (average best 25% outcomes) HPA and unemployment assumptions
- * Downside HPA assumption (incremental relative to base): -9% year 1, -8% years 2 and 3, -3% year 4, 0% thereafter
- * Upside HPA assumption (incremental relative to base): +3% year 1, +2% year 2, +1% year 3, 0% thereafter
- * Downside and upside HPA scenarios imply assumption that housing market is neither overvalued or undervalued at end of Q2 2021
- * Downside unemployment assumption (incremental relative to base): +3% year 1, +2% year 2, +1% year 3, 0% thereafter
- * Upside unemployment assumption (incremental relative to base): -0.25% year 1 to year 3, 0% thereafter
- * Rate paths still divided into three groups (25% downside, 50% base, 25% upside) to run the three HPA/unemployment scenarios
- * Rate paths still assigned to the three groups in a manner designed to minimize correlation between rates and HPA/unemployment

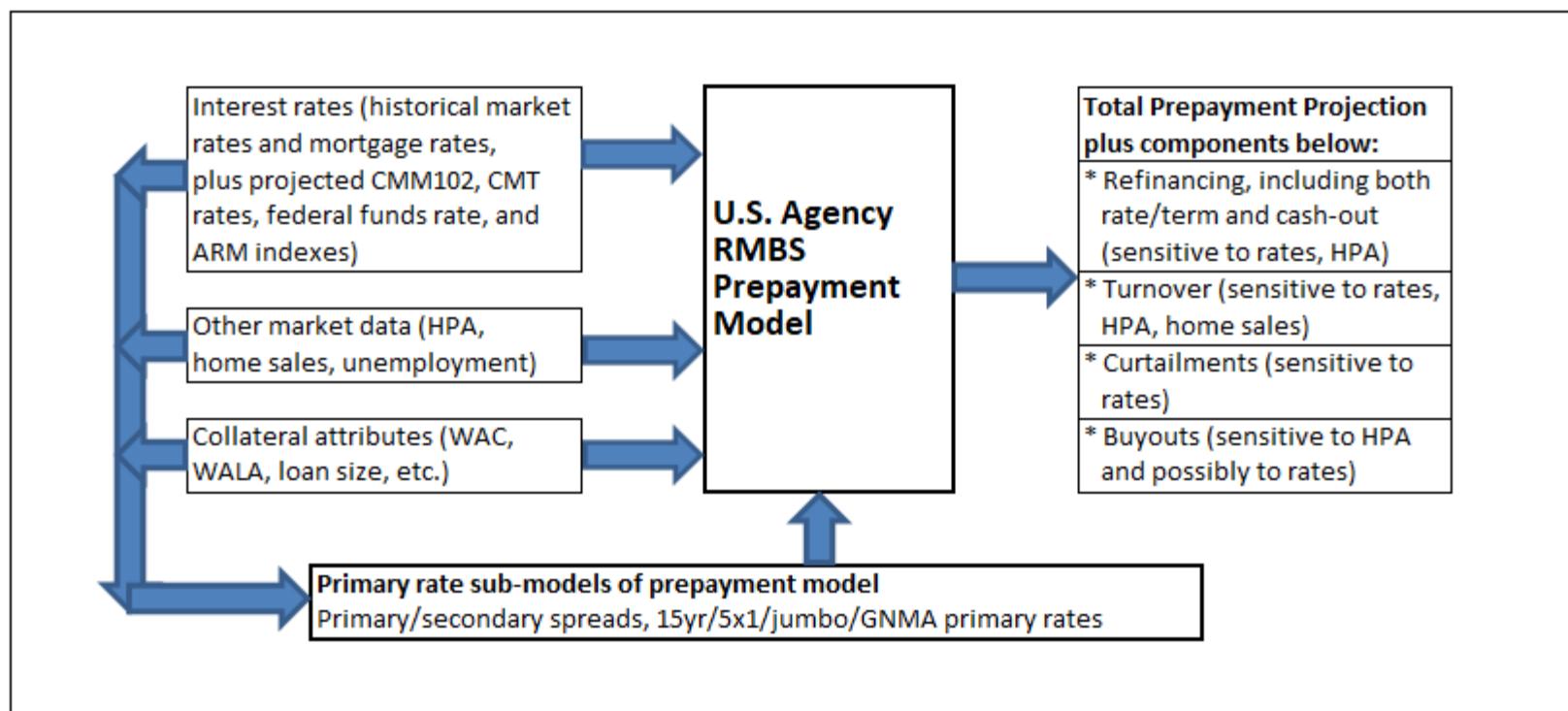
Medium/Long Term Development Plans (Post v21.7 Release)

- We expect a MOATS update to improve the TBA pricing algorithm along the stochastic interest rate paths, eliminating excessive volatility that occurs in the spread of CMM102 to projected swap and Treasury rates.
- We expect to adjust TPO collateral by seller rather than servicer; the broker populations working with a given seller are most relevant to speeds.
- For example, speeds on Quicken and United Shore originated collateral transferred to other servicers remain fast after the transfer; the current model slows speeds on these loans immediately after transfer.
- We also expect to make adjustments for selected state-level HFAs on top of generalized HFA adjustments.
- While not planned for a near-term production release of the model, we expect to develop separate prepayment models for FHA, VA and RHS. These segments will ultimately be grouped separately in GNMA pools/deals.
- Multiple replines will partially address the issue of different servicer and guarantor distributions on delinquent portion of pool vs. total; we will also consider solutions for the servicer distribution differences.

APPENDIX – MODEL DESIGN AND DEVELOPMENT

Agency Prepayment Model Specification

- Model objective -- project prepayment rates on agency mortgage collateral from settlement date to maturity, given collateral characteristics and a macroeconomic scenario. Agency mortgage collateral includes pools and CMOs backed by loans guaranteed by FHLMC, FNMA, or one of the four GNMA guarantors (FHA, VA, RHS, PIH).
- The prepayment model consists of numerous mathematical and computational algorithms coded in C and C++, along with parameters that specify scalars, vectors and functions of the data inputs to the algorithms. The parameters may be empirically estimated, postulated based on expert judgment, or definitively specified based on known relationships. The outputs of the model are the total prepayment rate and its components. The model may be represented schematically as follows:



Agency Prepayment Model Dataset

- Collateral and prepayment data for agency MBS are obtained from a vendor (eMBS) which transmits it from the agencies (who in turn collect it from loan servicers) with no alterations.
- Market data are obtained from the appropriate Citi, government or association source.
- The data provided by Fannie Mae, Freddie Mac, and Ginnie Mae through eMBS are considered to be the industry standard. The data has been used for decades for not only modeling, but also for official cash disbursements to investors by trustees for MBS; the proper sourcing and reliability of the data can safely be presumed.
- The time periods for the data extend through multiple economic cycles, in many cases from the 1970s to the present.
- The model requires certain data transformations; important transformations that affect prepayment projections on almost all collateral are outlined below.

Data Element	Transformation
Prepayment Rates	Computed from pool factors according to industry-standard methods; checked vs. eMBS reported values for consistency
Mortgage Rates	Daily mortgage rates are computed from the weekly primary-secondary spreads derived from the FHLMC PMMS. Reported rates and points are combined to produce no-point primary mortgage rates before the current coupon (secondary) rate during the survey period is subtracted to obtain the spread. This spread is added to the current coupon each day to obtain daily 30-year rates; daily 15-year and 5x1 ARM rates are then derived from the 30-year rates and reported weekly spreads of 30-year rates to 15-year and 5x1 ARM rates. Daily rates are then averaged and lagged before being used to compute refinancing incentives and turnover lock-in. Effective with model v21.4, average GNMA mortgage rates may be obtained by subtracting the spread between FNMA and GNMA II CMM102 from conventional mortgage rates, rather than by setting GNMA rates to conventional rates plus a fixed elbow shift.
Current LTV	Adjust original LTV by FHFA HPA and loan balance declines resulting from amortization and curtailments
SATO	Estimate spread of WAC at origination to prevailing mortgage rates based on assumed rate lock term and FHLMC PMMS.

Agency Prepayment Model Inputs

Collateral

- Collateral type (agency, mortgage term, fixed or hybrid adjustable rate, amortization type)
- Loan program (FHA/VA/RH for GNMA, HARP status for conventional)
- Loan purpose (purchase first-time or not, rate or cash-out refi, modification, reperformer)
- Origination channel (broker, correspondent, retail)
- Occupancy (Owner-occupied, second home, investor)
- Servicer (fraction serviced by significant servicers) and selected sellers (those who tend to transfer servicing, and HFA sellers)
- Geography (fraction in each state)
- Presence of second lien
- Presence of PMI, and PMI coverage fraction (current and original)
- Units (single or 2-4 family)
- Down payment assistance
- Origination date (average and quartiles)
- Note rate (average and quartiles)
- Note rate spread to market rates at origination (SATO)
- Credit score (average and quartiles)
- LTV/Combined LTV/Current LTV (average and quartiles)
- DTI (average and quartiles)
- Loan size (average and quartiles)
- Number of borrowers on loan
- Property type (e.g., single family, condo, coop, PUD)
- Property valuation method (e.g., appraisal, appraisal waiver, or none if a streamlined refinance)
- Mortgage insurance premiums (upfront and annual) charged by GNMA guarantors, if applicable
- Eligibility for HARP and/or other streamline refinance program (including new FHFA HTLV program starting in 2019)
- Eligibility for affordable housing program (FNMA HomeReady, FHLMC HomePossible, state Housing Finance Agency (HFA) assistance)
- Modified loan info (performance history, payment reduction, number/type of mods, forbearance/deferral amount)
- Delinquency status distribution (current, 30-59 days delinquent, 60-89 days delinquent, 90+ days delinquent, 120+ days delinquent)

Market

- Primary mortgage rates (30-year, 15-year, 5x1 hybrid, ARM indexed rates)
- Secondary mortgage rates (derived from FNMA and GNMA II TBA prices)
- Federal funds / LIBOR / SOFR / Treasury rates (for HELOC rates, ARM indexes, curve shape)
- Unemployment rate
- Home sales and housing stock (for turnover rate)
- Home price appreciation

Agency Prepayment Model Outputs

Each component of prepayments is modeled separately. Prepayment rates are projected for each component and added together to obtain the total prepayment rate.

Total Speed = Housing Turnover + Refinancing + Defaults + Curtailments/Payoffs

- **Housing Turnover.** An existing home sale generally leads to a mortgage prepayment if the seller carried a mortgage. An exception occurs if the seller had an FHA or VA loan and the buyer "assumed" the obligations of the existing loan.
- **Refinancings.** Refinancing refers to the retirement of an existing loan in favor of a new one on the same property. This is generally undertaken to take advantage of lower rates, but can also occur because the mortgagor wants to cash out equity in the home, or when borrowers with initially poor credit and/or high LTV take advantage of an improvement in their credit and/or an increase in their home value.
- **Defaults/Buyouts.** Defaults are prepayments caused by the foreclosure and subsequent liquidation of mortgage loans in the pool; buyouts are the repurchase of seriously delinquent loans from the pool. These constitute a minor component of aggregate prepayments in most cases, but may be more significant for GNMA loans, and during an economic crisis.
- **Partial Prepayments and Full Payoffs.** Some mortgagors send in more than the scheduled payment each month; full payoffs refer to mortgages that have been paid off completely, usually when the mortgages are very seasoned and the remaining loan balances are small.

Agency Prepayment Model Design and Development

- Drivers of prepayment components are identified (market data and collateral attributes). Many drivers are well known; others are revealed by data analysis and in consultation with model users.
- Data is passed in as a single repline of average and quartile data for each collateral type (30-year, 15-year, ARM, etc.). Multiple replines are not used due to slower run-times and limited benefit in most cases.
- Functional forms to convert the drivers into prepayments are determined. The decision to select one functional form over another is based on prior experience and simplicity.
- Initial guesses are selected for optimization, generally from the prior model version, and optimization is performed on each sub-model. Back-testing is the primary testing method used during the preliminary optimization stage.
- Following preliminary optimization, model parameters and outputs are examined via scenario analysis, particularly for extreme scenarios; OAS, duration and convexity are reviewed for actively traded MBS; and model vs. market pay-ups are examined for specified pools. These tests result in additional optimization before the model is released for user testing.
- Feedback resulting from internal and external user alpha and beta testing is incorporated. The above-mentioned tests are repeated where necessary and the model is frozen for release.

Agency Prepayment Model Segmentation

The agency prepayment model is segmented into sub-models by collateral type as follows.

Agency Prepayment Model Key Assumptions

- **The conditions and relationships observed in the past will generally hold going forward, with exceptions as appropriate when market conditions are not typical.** This is a broad assumption in that our model uses past actual speeds as a guide to model predicted future speeds; the past speeds are real observed data that should be given significant weight when current or future conditions are similar or expected to be similar.
- **The COVID-19 crisis will not take another turn for the worse, and will continue to resolve over the next 6-12 months, by which time the mortgage market is largely assumed to return to normal.** This assumption is built into various other model assumptions that are discussed further below.
- **Home price appreciation assumed to be 3% annualized long term, with possible short-term adjustments.** In general, we believe that home prices should appreciate slightly above long-term expected wage inflation over the long term, reflecting slightly higher wage growth for those capable of homeownership. Based on recent inventory, affordability, home price momentum, etc., adjustments may be made for a few years. The current economic environment is stressed, but housing prices and demand have been enhanced by low mortgage rates and a desire to invest in the home due to the conditions imposed by COVID-19. Model version 21.7 incorporates historical data through Q1 2021, and then a base case projection (annualized) of 20% for Q2 and Q3 2021, 12.5% for Q4 2021, and 3% per year thereafter. Note that projections for different geographies vary at the state level; a fraction (which declines linearly from one to zero over the next 36 months) of the appreciation difference between a given state and national over the past 12 months is applied to that state's HPA going forward.
- **Unemployment rates are assumed to follow a path consistent with the Economic Projections of Federal Reserve Bank Presidents and Board Members.** These forecasts are published quarterly (<http://www.federalreserve.gov/monetarypolicy>), and we believe that the Federal Reserve is among the best positioned to make accurate unemployment forecasts, although any such forecast is highly uncertain. Specifically, model version 21.7 is based on the June 2021 Fed forecast. Note that historical unemployment adds the BLS classification adjustment, meant to account for mis-reporting of COVID-related layoffs as temporary absences that are normally not considered as part of unemployment. Therefore for historical values, the model uses 6.4/6.4/6.1/6.1 vs. the official reported values of 6.0/6.1/5.8/5.9 for Jan-Apr 2021 (and larger adjustments from Mar-Dec 2020). Base case projected unemployment is ~4.5% in Q4 2021, down to 3.9% by Q4 2022, 3.5% by Q4 2023, and 4.0% in the long run.
- **The terms of the FHFA HLRO program for high LTV borrowers that replaced HARP at the start of 2019 are assumed to be similar in the future.** In August 2017, FHFA announced an extension of HARP to December 2018, and established a note date eligibility cutoff for the previously announced HLRO (October 2017 or later) along with a 15-month seasoning requirement to ensure that no such refinances would occur until HARP expired. In May 2018, Fannie Mae and Freddie Mac both announced LLPA caps for HLRO loans and confirmed that a minimum of a 97 mark-to-market LTV was required. Other than the high LTV requirement and the ability to use HLRO multiple times (as opposed to single-use for HARP), HLRO is substantially the same as HARP and the model assumes HARP-like prepayments on loans that become eligible for the program if HPA declines. In May 2021, this program was temporarily suspended to reconcile it with the updated QM definition, but we expect it to be reinstated in similar form before a significant number of borrowers become eligible (which has not occurred to date due to continually rising home prices).
- **The long-term US housing turnover level (including homes without a mortgage) is assumed to be about 5.2%.** This is about the average ratio of existing single family home sales (as published by the National Association of Realtors) to single family housing stock (as published by the Census Bureau) over the past forty years. The model also approximates the relative mobility of mortgaged borrowers to mortgaged borrowers at a ratio of 1.2, consistent with levels observed on average over time.
- **GSE guarantee fees (g-fees) are assumed to remain at current levels going forward.** In April 2015, FHFA announced modest updates to its LLPA matrix, and indicated a view that g-fees were at roughly appropriate levels. G-fees declined slightly in 2016 and 2017, resulting in FHFA imposition of minimum g-fee and ROE levels to prevent further declines. Effective December 2020, a 50 bps adverse market LLPA was imposed on all new GSE refinance loans; this was terminated as of August 2021. FHFA has not directly proposed further g-fee changes, although in 2020 it proposed a GSE capital plan that could result in g-fee increases following exit from government conservatorship (which may be less likely after Mark Calabria was replaced as FHFA director). Furthermore, Congress legislated a 10bps increase under the Tax Cut Continuation Act of 2011 (TCCA), passed directly to the U.S. Treasury starting in 2012. While scheduled to expire in October 2021, past government budget proposals have extended this fee. The 2022 WH budget proposal, while not mentioning TCCA, included significant housing-related increases. And an extension has already been included in a bipartisan Senate infrastructure bill. Given this uncertainty, the 10 bps TCCA charge is not removed by the model at its stated expiration.

Agency Prepayment Model Key Assumptions (continued)

- **Mortgage insurance premiums (MIPs) for the four GNMA guarantors (FHA, VA, RH and PIH) are assumed to remain at current levels going forward.** In January 2015, FHA surprised market participants with an immediate 50 basis point reduction in annual MIP, before FHA's insurance fund had recovered substantially. A subsequent additional cut of 25 bps announced at the end of the Obama administration was rescinded immediately after the Trump administration took power in January 2017. FHA may consider a decrease after reviewing 2021 Mutual Mortgage Insurance Fund (MMIF) reserve levels, because COVID-related losses have been modest so far and a Democratic administration has taken over. Grandfathering of MIPs for FHA borrowers originated prior to June 2009 is assumed to continue indefinitely, although this is a small segment of the market now. With regard to other guarantors, VA MIPs have not changed in many years. RH made gradual increases over several years after the crisis, followed by a reduction in October 2016. At this time, we assume no further changes in the foreseeable future for VA, RH, or PIH MIPs.
- **Primary mortgage insurance rates (PMI) applicable to conventional loans above 80 LTV are assumed to remain at current levels going forward.** PMI companies such as Arch, Radian, Genworth and MGIC made major changes to their pricing grids in early 2016, and subsequently adjusted rates lower in 2018 following the corporate tax cut (while also adding overlays for high DTI loans). Given these fairly recent changes, the model assumes no further changes in the foreseeable future. That being said, it is possible that some pricing changes in the PMI market may ultimately occur if the GSEs enter the market with an enterprise PMI offering, which has been piloted by Fannie Mae. But because PMI typically affects only a limited subset of the refinancing market (i.e., those with LTVs over 80% and not eligible for any grandfathering program such as HARP or HLRO), we expect any such pricing changes to have a minor impact relative to other factors that could increase or decrease the net cost of the typical mortgage loan (such as guaranty fees).
- **Conforming loan limits are assumed to grow in line with our HPA assumption in 2021 and beyond.** While it is not clear what the ultimate government role in the mortgage market will be or what loan size limits will apply, we are assuming for now that GSE-type of guarantees will continue to be available for the existing limits, and such limits will increase in line with our expected HPA assumption. Reinforcing this assumption was the decision by FHFA director Mel Watt not to lower the existing loan limits in 2014, as well as the request for comment regarding FHFA's proposal regarding how the limits would be raised in the future (<http://www.fhfa.gov//Media/PublicAffairs/Pages/Input-on-HPI-Measure-for-Conforming-Loan-Limits-for-Fannie-and-Freddie.aspx>), which was subsequently implemented. The first loan limit increase in many years was announced for 2017, with additional increases applicable in 2018, 2019, 2020, and 2021 (latest announcement: <https://www.fhfa.gov//Media/PublicAffairs/Pages/FHFA-Announces-Conforming-Loan-Limits-for-2021.aspx>).
- **LTV limits imposed by GSEs and FHA/VA/RH are not assumed to change going forward.** The GSEs allow LTVs up to 97% on rate refinances (with some exceptions for loans originated through state housing finance authorities) and 80% on cash-out refinances (down from 85% effective in late 2014). FHA does not impose LTV limits on streamlined rate refinances, and allows cash-out refinances up to 80% LTV (down from 85% for FHA case numbers effective Sep 1, 2019) plus the financing of the upfront MIP. VA does not impose LTV limits on streamlined rate refinances and allows cash-out refinances up to 100% LTV (effective Feb 15, 2019 the limit is reduced to 90% unless one of a number of conditions are satisfied, and no longer allows the financing of the VA funding fee into the cash-out loan if it would bring the LTV over 100%). Effective November 1, 2019, GNMA does not allow VA cash-out loans with LTVs exceeding 90% to be pooled into their TBA deliverable pools. Rural Housing does not impose LTV limits on streamlined rate refinances and does not permit cash-out refinancings. While cash-out NTB tests may become stricter, we assume no change in the maximum LTVs permitted as part of those revised tests.
- **Mortgage origination fees and costs are assumed to remain stable at current levels on average over time.** We assume that pricing for borrower-paid items, such as title insurance, legal fees, appraisals, etc. that are typically included in these fees will not change materially from current levels. Both Fannie Mae and Freddie Mac have introduced streamlined digital underwriting which offers appraisal waivers on many rate refinances and some purchase loans and cash-out refinances as well. The fraction of loans offered such waivers are available in data supplied by the GSEs, and the model accounts for the known data and expected trajectory. The GSEs have also introduced programs (RefiNow and RefiPossible) that cover appraisal costs for low-income borrower refinancings under certain conditions. Overall, despite these savings, we believe regulatory changes have significantly increased origination costs and fees (including servicing costs) following the housing bubble and its collapse in the 2000s. We assume no further reduction in origination costs and fees, either tangible or intangible (the latter referring to the perceived convenience of refinancing). Increased digitization of mortgage underwriting could result in additional efficiency improvements which could materially increase prepayments. But in our view, much of this has already been realized, and significant portions of origination costs (e.g., related to marketing, regulatory compliance, delinquency resolution) seem unlikely to decrease.

Agency Prepayment Model Key Assumptions (continued)

- **Primary secondary spread (versus CMM102) is assumed to be in the 50-125 bp range except under extreme conditions.** This range has applied over most of the post-housing-crisis period. While it is possible that the spread could go outside of that range, particularly under extreme conditions (and has done so during the COVID-19 crisis), a materially lower value is likely to make originations uneconomical, while a materially higher value would invite significant competitive pressures and regulatory scrutiny. This range has expanded over the past few years. On one hand, stronger competition, a flatter yield curve and very high WAC spreads in late 2018 and early 2019 led to the lowest P/S spread levels in many years. The high WAC spreads compressed the TBA stack and increased the spread between CMM102 and CMM100, driving originators to pool their loans into lower coupons (because their excess servicing valuations or the pricing they received from the GSEs for buying up the guarantee fee exceeded the servicing value implied by TBA prices). On the other hand, the extreme rate rally, Fed intervention in the TBA market, and disruption of the mortgage origination process during the COVID-19 crisis resulted in the P/S spread widening to unprecedented levels in 2020. While the spread remains at historically wide levels into mid-2021, it has fallen to 90-95 basis points and would likely remain in its pre-COVID historical range unless there is another extreme stress event.
- **The levels of 15-year and hybrid ARM mortgage rates relative to the 30-year mortgage rate will be consistent with levels over the past several years, and remain closely correlated to changes in 5-year CMT rates vs. 10-year CMT rates.** The model assumes that the shape of the curve is the primary driver of relative 30-year, 15-year and 5x1 ARM mortgage rates, and that the relationship between the spread of 30-year mortgage rates to 15-year/5x1 mortgage rates and spread of 10-year to 5-year CMT rates will be consistent with the average since mid-2013, as estimated using single-variable linear least-squared error. Prior to model version 21.7, swap rates were used, but we switched to CMT because of LIBOR replacement initiatives. Mid-2013 was chosen as a starting point for the estimation because it follows by several months the relative guaranty fee changes between 15-year and 30-year loans mandated by FHFA and implemented by the GSEs in late 2012. We recognize that additional factors may affect relative mortgage rates, such as different servicing costs for different mortgage types, varying levels of bank retention of shorter-term mortgages such as 15-year loans, and relative pricing in the secondary market for 30-year and 15-year TBAs. But such factors are not specified as part of scenarios such as CCAR or in the Monte Carlo simulations used to compute OAS/OAD/OAC, and in any case would be non-stationary and very difficult to observe and/or project.
- **The relationship between GNMA and conventional primary rates is related to the relationship between production UMBS and GNMA II TBA pricing under normal conditions.** During the relatively stable market and regulatory environments from late 2016 to late 2018 and mid 2019 to early 2020, correlation was very high between relative GNMA II and conventional TBA pricing, as measured by the spread between FNMA CMM102 and the GNMA II 102-priced TBA computed on the same basis. This correlation broke down during the run-up to the advent of UMBS in mid-2019, and then again during the COVID-19 crisis. Model version 21.7 assumes that correlation between FNMA/GNMA primary and secondary rate differences will be about 50% on average over time.
- **Underwriting standards are assumed to remain consistent with current levels over the next few years, but are correlated with home prices.** The economic/housing crisis of 2007-2011 resulted in a swing from very loose to very tight underwriting standards. Underwriting standards loosened over the next several years as home prices recovered. Standards tightened temporarily after the COVID crisis unfolded but subsequently loosened again with the strength of the housing market. The memory of the housing and COVID-19 crises are likely to persist for at least a generation, and we believe a return to underwriting standards prevailing before the housing crisis will not occur in the foreseeable future.
- **A presumed surge in cash-out refinancings in the spring and summer of 2018 is modeled as temporary in part; cash-out declines are modeled for GNMA from an assumed final VA cash-out NTB test and future FHA cash-out NTB test.** We believe a number of factors created a "perfect storm" to drive cash-out refinancings in 2018. These include a back-up in interest rates and new refinancing restrictions for GNMA loans that left originators with excess capacity; a housing inventory shortage that made it difficult for many homebuyers to upgrade, leaving them to renovate via cash-out financing instead; a tax-cut that increased awareness of cash-out lending and provided more disposable income; high short-term rates that made the cash-out vs. HELOC equation more favorable for the former, more permissive DTI requirements from the GSEs (these were partially rolled back in late 2018), and special cash-out provisions for those paying off student loans. The impact of short-term rates and excess capacity are modeled explicitly for model versions 21.5 and later; other factors are assumed to have normalized. It is also assumed that the final VA cash-out NTB rule will be stricter than the interim rule, and that FHA will ultimately make changes to cash-out rules, such that non-economic cash-out refinances under both guarantors will be reduced. It appears that the COVID-19 crisis has delayed development of the final VA NTB test, and we are currently modeling no changes until 2023. In any event, the impact of these changes on cash-out lending is minor compared to the impact of HPA, which we believe is the most important driver of cash-out refinancing.

Agency Prepayment Model Key Assumptions (continued)

- **Model refinancing S-curves are assumed to be materially higher than 2012-2016 S-curves, but not to fully revert to peak S-curves from 2003.** As mentioned above, the regulatory and underwriting changes since the crisis are expected to be long-lived. Without significant streamlining of the refinance process, either from technological advances or the implementation of a streamline refinance program from the GSEs that is not limited to very high LTV loans on depreciated homes, S-curves are unlikely to fully return to peak levels experienced in 2003. Technological advances have in fact accelerated in recent years with Quicken's Rocket Mortgage and similar programs from other originators, and increasing adoption of and enhancements to the GSE automated underwriting programs (FNMA's Day One Certainty and FHLMC's LoanAdvisor Suite). These programs offer property inspection waivers (PIW) that eliminate the need for appraisals on many properties, and also automate other aspects of underwriting like income and asset verification. We believe mortgage digitization is the primary driver of the substantial shift higher for S-curves on newer, high-quality loans in 2019-2021 versus 2012-2016; and it appears that the benefits have spread more broadly during the COVID-19 crisis. The GSE programs also benefit mortgage originators, in that they reduce the risk that the loans are later found to be defective by FNMA or FHLMC. In addition to these advances, it is also possible that FHFA and the GSEs will move toward universal streamlined refinancing (as permitted by the three major GNMA guarantors -- FHA, VA and RH) over time. This would likely accelerate prepayment rates even more broadly and significantly, but no such assumption is currently made for model version 21.7.
- **The surge in refinancings during the COVID-19 crisis is in part attributable to a temporarily elevated media effect and special flexibilities offered by the GSEs and GNMA guarantors.** We believe there was higher-than-normal borrower contact with servicers due to the right to request forbearance under the CARES Act, as well as the economic slowdown and remote work requirements imposed by COVID-19. At the same time, the GSEs offered significant appraisal flexibilities and appraisal waivers on refinances. These factors likely carried over into an elevated media effect, greater than what would occur based solely on the declines in mortgage rates. However, we believe that with the lifting of most COVID-related social restrictions in the summer of 2021, media effect has likely normalized to pre-COVID levels.
- **The surge in delinquencies during the COVID-19 crisis will result in elevated buyouts from agency MBS pools over the next 6-12 months, and that no significant additional changes in workout waterfalls or buyout rules will occur.** Forbearance rates on MBS peaked between 6% and 7% for conventional agency MBS and around 12% for GNMA. The GSEs (FNMA and FHLMC) have indicated that loans will not be repurchased from pools while in forbearance, nor would loans that are able to resume making the original contractual payments as part of a reinstatement, repayment plan, or payment deferral modification. Thus we assume that the level of buyouts for conventional loans will be substantially below the level implied by the number of loans reaching four months of delinquency that historically resulted in a GSE buyout of the loan, and that the buyouts will primarily occur from mid-2021 to mid-2022 (during which substantially all remaining COVID-19 forbearances are expected to be resolved). For GNMA, a larger fraction of the loans receiving forbearance are assumed to be bought out, as no buyout restrictions have been imposed by GNMA on servicers (for GNMA, it is the servicer rather than the guarantor that determines whether to buy out the loan). Reinstatements, repayment plans or payment deferrals do not require buyouts (as for conventional). But while some restrictions have been imposed on re-pooling loans that are not required to be bought out, bank servicers have nevertheless bought out loans very aggressively given low financing costs, high expected profitability in re-pooling the loans, and accounting rules requiring banks to account for loans on balance sheet if an option to buy them is in-the-money. While non-banks have generally been less aggressive (financing is more costly and harder to come by), several non-banks have completed significant buyouts, especially on higher-coupon loans. We assume that highly economic buyouts will continue at a rapid pace, and assume that a higher fraction of GNMA loans will ultimately require modification (and thus a buyout) than conventional, since GNMA borrowers typically are weaker financially. The ability to re-pool COVID-related FHA modifications quickly (no trial payment plan is required) and recent modification options introduced (particularly FHA's Advance Loan Modification and COVID Recovery Modification) are assumed to further support higher buyout rates on GNMA loans remaining delinquent and still in their original pools, as compared to conventional.
- **Borrowers obtaining forbearance may obtain new loans without the normal credit impact associated with borrower delinquencies.** Both the GSEs (as announced by FHFA on May 19, 2020) and FHA (via ML 2020-30 on September 10, 2020) generally allow borrowers that exited forbearance to refinance after three payments (or a non-credit qualifying streamlined refinance in the case of FHA), with fully reinstated loans (GSEs) or credit-qualifying borrowers (FHA) eligible immediately. And in most cases, VA borrowers may refinance when delinquent even if forbearance has not been granted. The model has never had any adjustments for "dirty current" fraction. So borrowers who are current (including after a COVID-19 payment deferral) are assumed to be permitted to refinance, regardless of past delinquency. In effect, FHFA and GSEs are allowing that, with a three month delay in some cases and no delay in other cases. In general terms, model v21.7 therefore captures FHFA and FHA guidance in principle by its existing assumption that current loans may refinance, in combination with its existing impairment adjustments for weaker credit loans.

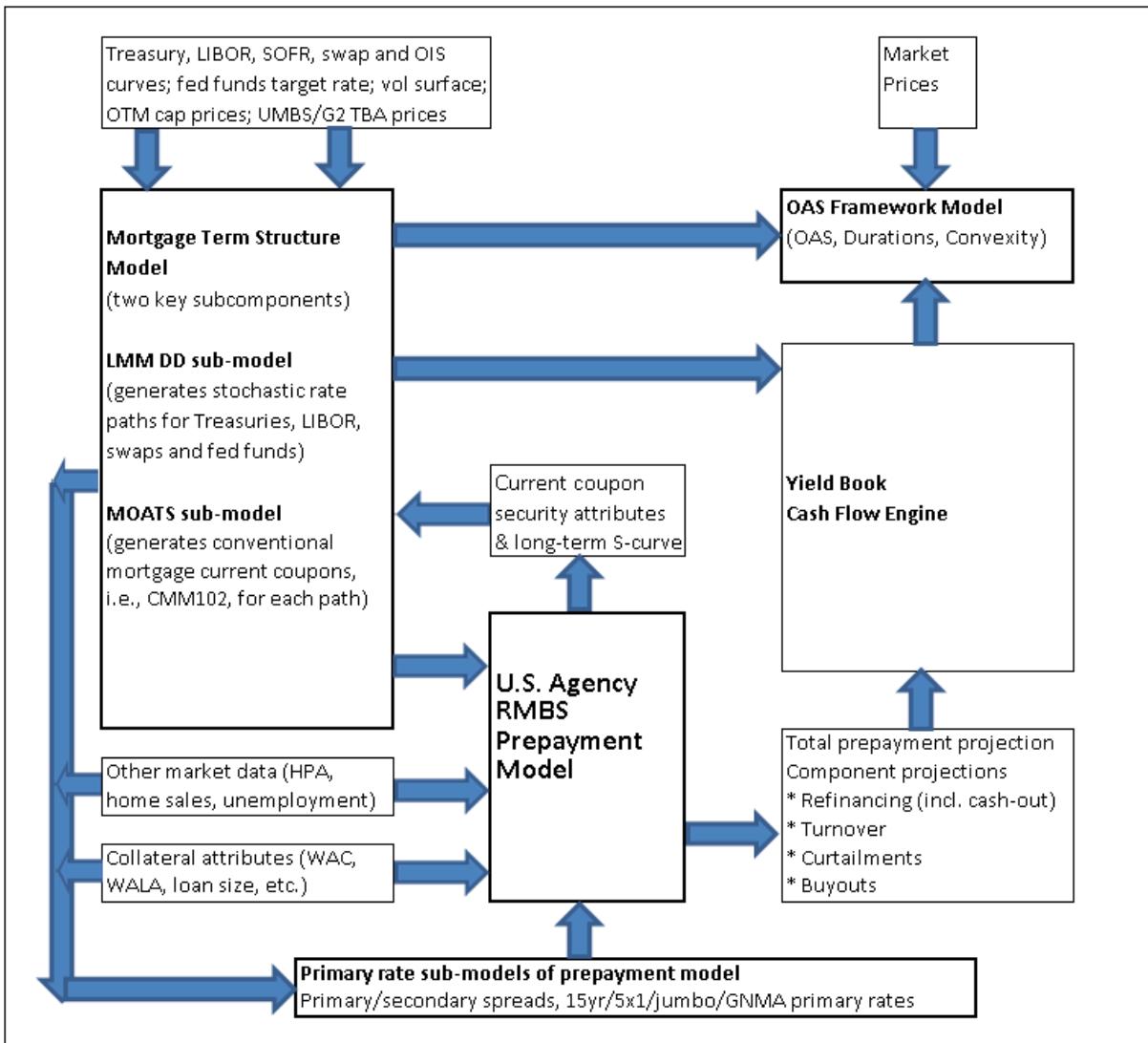
Agency Prepayment Model Limitations

The basic premise for the agency prepayment model is that conditions and relationships observed in the past will hold going forward. If certain collateral prepaid at a certain rate under certain interest rate, housing market, and economic conditions, the model generally assumes a similar prepayment rate under similar conditions in the future. Such an approach has a number of important limitations.

- A large body of data now exists on prepayments, but it still only partially covers the range of interest-rate and macroeconomic environments that is possible over the term of a mortgage-backed security (MBS). In particular, in the past there have not been negative interest rates, and in the recent past (since the early 1990s) there have been few periods of interest rates much higher than the mortgage rates for loans deliverable into the lowest coupon TBA.
- Other factors that determine prepayments that are not necessarily or directly related to collateral attributes or macroeconomic environments -- borrower demographics, loan origination and servicing practices in the mortgage lending industry, government regulations, the costs and ease of refinancing, borrower responsiveness, etc. -- change over time, often in unpredictable ways. In particular, the impact of digital mortgage technology could ultimately be quite disruptive, but the model cannot reasonably predict this except to the extent that it is reflected in past data and is based on specific program announcements (e.g., Day One Certainty from FNMA and LoanAdvisor Suite from FHLMC, including requirements to obtain a PIW).
- The long-term status of the GSEs (FNMA and FHLMC) unclear, given their failure during the 2008 housing crisis, their current status in government conservatorship, and the numerous GSE reform proposals under consideration. Even absent any material change in the status of the GSEs, future policy changes by the GSEs or their regulator (The Federal Housing Finance Agency, or FHFA) could have a significant impact on prepayment rates. For example, a crisis could prompt an expansion of the high-LTV streamlined refinancing program (HLRO) that replaced the crisis-era HARP program in December 2018. At present, HLRO is only available to borrowers whose loans did not originate through the HARP program and whose LTVs exceed the normal maximums permitted by the GSEs (97 for most loans). HLRO could be expanded immediately during a crisis, especially under a significant rally when many borrowers could benefit, or more gradually over time absent a crisis.
- The Qualified Mortgage (QM) standards went into effect in early 2014. While the existing GSE and government loans are exempt, all guarantors are likely to converge to these standards over time. A re-examination of QM was completed by CFPB and went into effect March 1, 2021, and included elimination of the maximum permitted DTI of 43 in favor of a price-based threshold, as well as extension of the exemption for GSE loans until the GSEs exit government conservatorship (although the PSPA with Treasury required immediate GSE compliance). Furthermore, updated standards for compliance with Truth in Lending Act and RESPA Integrated Disclosure requirements became effective in late 2015. Finally, there have been significant changes to short-term underwriting and loan servicing requirements due to the COVID-19 crisis, some of which may become permanent or influence permanent updates. All of these new regulatory requirements have already affected the underwriting and servicing environment to some degree, and may (along with any additional changes in the future) ultimately cause underwriting standards to vary from our assumptions.
- There is uncertainty regarding the breakdown of voluntary prepayment speeds into housing turnover, rate refinance, cash-out refinance, and full payoff components of model projections, as these speeds cannot be observed directly.
- The crisis period from 2007 through 2011 was characterized by falling home prices, tight underwriting, high unemployment, and low home sales, dramatically affecting all three major components of prepayments (refinancings, turnover and defaults). Over the ensuing years, home prices turned around and the other issues have eased; at the same time, new non-bank servicers emerged that refinance borrowers very aggressively. In 2020, the COVID-19 crisis emerged, again dramatically affecting the three major components of prepayments. Clearly, sharply changing market conditions can and has led to model errors..
- Collateral attributes (with the exception of loan size and LTV, which change based on assumed amortization and state-level actual and projected home price appreciation) do not change over the model projection period. This may introduce errors, particularly from changes in critical attributes like WAC, credit scores, DTI ratios, guarantor distribution, origination channel distribution, and servicer distribution. While some of this drift could be captured with a multiple repline approach, there is still a great deal of uncertainty about evolution of collateral attributes over time. For example, unless each repline is completely homogeneous, some drift will occur within the repline. Furthermore, attributes of individual loans (e.g., credit score and DTI, and improvements or deterioration in the underlying property) are likely to change over time, and are not updated (and in many cases could not be updated) in the monthly agency disclosures.

Agency Prepayment Model Framework And Dependencies

The model's framework and dependencies are illustrated by the diagram below.



Notes:

For stochastic paths, secondary mortgage rates are determined by the mortgage term structure model (LMM DD interest rate sub-model based on normal vols and supporting negative interest rates, and the MOATS current coupon sub-model).

Prepayment model parameters determine the MOATS S-curve (calibrated to match the long-term model projections for different incentive levels) and MOATS current coupon security repline (whose attributes are set to match new production TBA collateral).

Primary mortgage rates are derived from secondary rates using a P/S spread sub-model to obtain conventional 30yr primary rates; separate sub-models obtain 15-year/5x1/jumbo/GNMA primary rates from 30-year conventional rates.

Yield Book provides the cash flow engine to incorporate prepayment projections into security cash flows.

The OAS framework model uses discount factors from the LMM model and cash flows from the cash flow engine to compute option-adjusted spread, duration and convexity.

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