Quantifying the Savings from the GSEs' Home Retention Programs

Kanav Bhagat
Housing Risk and Policy Advisors
June 2025, Revised July 2025

Acknowledgements

This paper evolved from policy discussions with the Housing Policy Council and the author and formalizes research results presented and discussed at the Housing Policy Council's Annual Meeting in May 2025. HPC's goal in publishing this work is to make this important research available to a broader audience. HPC believes that it is important to enhance understanding of the purposes, limitations, and results of servicer loss mitigation activities on behalf of mortgage credit risk holders. The author received valuable input and feedback from HPC during the course of his research but retains sole responsibility for the analysis and conclusions in the paper. The author would like to thank Recursion for providing access to their data and analyzers, which were instrumental to the analysis described in this paper.

About the Housing Policy Council

The Housing Policy Council is a trade association comprised of the leading national mortgage lenders and servicers; mortgage, hazard, and title insurers; and technology and data companies. Our interest is in the safety and soundness of the housing finance system, the equitable and consistent regulatory treatment of all market participants, and the promotion of lending practices that create sustainable homeownership opportunities in support of vibrant communities and long-term wealth-building for families. For more information, visit www.housingpolicycouncil.org.

About the Author

Kanav Bhagat is the President of Housing Risk and Policy Advisors, a consulting firm that provides strategic advice and research on policy-related issues in housing finance. Previously, he was a Research Director for the JPMorgan Chase Institute, where he led a team using the administrative data of JPMorgan Chase & Co to conduct housing finance and financial markets research designed to help policymakers, business leaders, and non-profit decision makers make more informed policy choices. In a prior role, Kanav served as the Global Head of Interest Rate Trading at J.P. Morgan, where he managed a global team responsible for the trading, risk-management, and capital management of financial products in G10 interest rate markets. Kanav earned a BS in Electrical Engineering from Cornell University and an MBA from the University of Chicago. His research is available at Author Page for Kanav Bhagat :: SSRN.

Revisions

This paper was revised in July 2025 to reflect the fact that if the GSEs were to replace payment deferral and the Flex Mod with market-rate modifications, then borrowers facing temporary *and* ongoing hardships would be offered market-rate modifications. Accordingly, the results have been revised after incorporating a second redefault function for borrowers who state that they can afford to resume their monthly payment yet are provided with market-rate modifications that provide varying amounts of payment changes. While the savings from the GSE home retention programs relative to market-rate modifications have been reduced modestly, the substance of the original findings, recommendations, and conclusions are unchanged.

Introduction and Executive Summary

For decades now, Fannie Mae and Freddie Mac, the Government-Sponsored Enterprises (GSEs), have required mortgage servicers to perform loss mitigation on GSE loans to resolve delinquencies and reduce foreclosure-related losses. The GSEs hold the risk of loss associated with borrower default, so it is in their economic interest to direct servicers to engage in risk management techniques that will reduce the number and severity of losses.

The purpose of loss mitigation, then, is to minimize the number of defaults that transition to foreclosure and the related losses. To do so, the GSEs instruct mortgage servicers to deploy loss mitigation solutions in a specific order, moving from early intervention assistance (when necessary) to home retention and then home disposition. The last option to be deployed in the hierarchy is foreclosure.

The GSEs require servicers to move sequentially through the hierarchy, which is organized from least costly to most costly for the guarantor, to find the least-costly solution that effectively resolves the delinquent loan. Within loss mitigation, the GSE home retention programs, which include payment deferral and the Flex Mod, serve a specific purpose: to enable delinquent borrowers to reperform and allow the GSEs to avoid the high cost of dispositions and thus mitigate losses that they would otherwise incur.[1] We estimate that each disposition today costs the GSEs about $72,000.[2] In that context, the home retention programs offered by the GSEs have averted billions of dollars in government losses from dispositions.

The purpose of this paper is to answer the question "what is the financial impact of the GSE home retention programs?" To do so, we quantify the cost of the current GSE home retention programs and compare those costs to two alternative loss mitigation scenarios—one that includes only dispositions and a second that includes only a traditional market-rate modification.[3] We then measure the financial impact on the GSEs if they were to eliminate payment deferral and the Flex Mod, or replace them with a market-rate modification, using the difference in costs under the three alternative scenarios.

We find that removing or reducing available home retention alternatives will lead to higher overall costs for the GSEs. Notable observations from this analysis are:

---

[1] See *Home Retention Programs Save the GSEs and FHA Billions by Avoiding the High Cost of Preventable Dispositions* on HPC Educational Resources page for a discussion of home retention best practices and an overview of the GSE home retention programs.

[2] Dispositions include foreclosures, third-party sales, short sales, deeds-in-lieu of foreclosure, and non-performing loan sales. Calculated as the product of the UPB at default of the average seriously delinquent GSE loan ($257,750) and the average Fannie Mae loss severity on home dispositions between 2018 and June 2024 (28%), sourced from Statistical Summary Tables. Among these disposition options, foreclosure typically is the costliest and hence the last option in the hierarchy.

[3] A market-rate modification adds missed payments to the loan balance, sets the modified interest rate to the current Freddie Mac Primary Mortgage Market Survey rate + 0.25%, and extends the term to 30 years.

1. After accounting for self-cures and post-intervention redefaults, every home retention action that the GSEs complete saves them $19,000 compared to a disposition and $11,000 compared to a market-rate modification.[4]
2. The more dispositions these programs prevent, the more the government saves: at today's low rates of serious delinquency, the GSE home retention programs will save $1.4 billion by averting 29,000 dispositions. Should the serious delinquency rate rise to the COVID-19 pandemic high, the GSEs would save $14.7 billion by averting about 304,000 dispositions.
3. The savings created by the GSE home retention programs relative to dispositions and market-rate modifications persist unless the mortgage rate quickly rises above 9.50% or loss severity averages a historically low 11%, which is likely unrealistic. Even with strong house price appreciation, GSE loss severity between 2018 and 2024 averaged 28%.
4. Payment deferrals generate loan reperformance at a high rate and the cost is less than half of the cost of dispositions and market-rate modifications.
5. Flex Mods generate loan reperformance and reduce dispositions in all interest rate environments, in contrast to market-rate modifications.
6. The GSEs could improve the cost-effectiveness of their home retention programs by providing delinquent borrowers with a home equity estimate and re-ordering the Flex Mod steps.

In this paper, Section I summarizes the savings generated by the GSEs' home retention programs compared to dispositions and market-rate modifications at the loan and portfolio level. Importantly, our analysis accounts for borrowers in default who self-cure (e.g., by securing the funds needed to make up missed payments or completing a market sale) and borrowers who receive a home retention alternative but then redefault and lose their home to disposition. In Section II, we provide the individual costs and performance of disposition, payment deferral, Flex Mod, and a market-rate modification, which collectively form the basis of our analysis.

In Section III, for our three loss mitigation scenarios, we show how our assumptions lead to different proportions of three outcomes: reperformance, self-cure, or disposition. Based on our analysis, we conclude that removing or reducing available home retention alternatives will lead to higher overall costs for the GSEs. We also provide the rationale behind our assumptions for take-up rates, redefault rates, transition rates from default to disposition, and loss severity. In Section IV, we conclude.

[4] Self-cures occur when a seriously delinquent borrower repays past-due amounts without using loss mitigation, for example by selling their home on the private market or obtaining funds from family or friends.

In the Appendix, we describe our representative seriously delinquent (SDQ) GSE portfolio and detail our calculations for the cost of dispositions, payment deferral, Flex Mod, and market-rate modifications. In addition, we test the sensitivity of our results to our model inputs and find that the savings created by the GSE home retention programs are persistent across a wide spectrum of scenarios. We also highlight several reasons why we underestimate the savings generated by the GSE home retention programs.

To be sure, foreclosure is still necessary when a home is abandoned, a delinquent borrower fails to engage with his or her servicer, or the borrower's financial circumstances deteriorate too much. But the central lesson is clear: by reducing the risk of disposition through improved home retention programs, the GSEs save the government billions of dollars. That is, by offering assistance to borrowers with a willingness to pay and an ability to make some reasonable payment, the GSEs' credit losses will be less than those associated with a disposition.

Section I: Summarizing the Savings Generated by the GSEs' Home Retention Alternatives

In this section, we summarize our results for the GSEs' savings per home retention action taken, which are estimated using model inputs set to through-the-economic cycle values. We then apply those savings to the existing set of SDQ GSE loans to estimate the GSEs' savings at the portfolio level.

GSE Savings per Home Retention Action Taken

Our top-line results for the savings per GSE home retention action noted in Finding 1 are summarized in Table 1 and illustrate the value of cost-effective home retention alternatives relative to disposition. We estimate that the GSEs' home retention alternatives save the GSEs about $18,700 per completed action, reducing the disposition rate among SDQ loans by 64%, presented below, declining from 60% to 22%.[5] Compared to a traditional market-rate modification, the GSEs' current home retention alternatives save about $11,100 per completed action and cut the disposition rate for SDQ loans by 52%, declining from 45% to 22%.

Table 1. Summary of Costs and Relative Savings from GSE Home Retention Alternatives.*

Loss Mitigation Scenario	Expected Cost per SDQ Loan ($)	Expected Cost per SDQ Loan (% of UPB at Default)	Disposition Rate for SDQ Loans
No Home Retention (Disposition Only)	**43,337**	**17%**	**60%**
Traditional 30-year Market-Rate Modification	**35,783**	**14%**	**45%**
Savings vs. No Home Retention	7,554	3%	15 pp
Savings vs. No Home Retention (%)	17%	17%	26%
Current Home Retention	**24,667**	**10%**	**22%**
Savings vs. No Home Retention	18,670	7%	38 pp
Savings vs. No Home Retention (%)	43%	43%	64%
Savings vs. 30-year Market Rate Modification	11,116	4%	23 pp
Savings vs. 30-year Market Rate Modification (%)	31%	31%	52%

Source: Author's calculations.

*The abbreviation pp refers to percentage points.

It is important to emphasize that these estimates also account for other voluntary actions that reduce dispositions, such as SDQ borrowers who self-cure by repaying past due amounts without using loss mitigation (e.g., by completing a market sale or obtaining funds from family or friends) and thus impose little or no cost on the GSEs. Our analysis also includes actions that may increase losses, such as SDQ borrowers who receive assistance but subsequently redefault and lose their homes to disposition. The figures also reflect mortgage insurance payments made to the GSEs. We express our cost estimates for dispositions and the GSEs' home retention alternatives as an average *per SDQ loan*, including those SDQ loans that self-cure, because, while not every SDQ loan goes to disposition, most SDQ loans are offered a home retention alternative.

[5] Here and hereafter, serious delinquency and default are defined as missing three or more mortgage payments.

In our analysis, we compare the cost to the GSEs under three alternative loss mitigation scenarios. The first is the current approach, which includes the home retention alternatives payment deferral and Flex Mod. For borrowers who redefault after using a home retention alternative but cannot self-cure, the next step in the GSEs' loss mitigation programs are disposition alternatives, which include third-party sales, short sales, deeds-in-lieu of foreclosure, and non-performing loan sales. Disposition alternatives are less costly to the mortgage guarantor than foreclosure, which is the final step in loss mitigation. However, because our loss severity data is averaged across all home dispositions, we treat disposition alternatives and foreclosure as a single outcome in our analysis and, when referring to our results, use the term "disposition" broadly to include both disposition alternatives and foreclosure.

The second scenario is a loss mitigation scenario without home retention. That is, we remove payment deferral and the Flex Mod from the current set of loss mitigation programs. Therefore, all SDQ GSE borrowers either self-cure (40%) or are evaluated for disposition (60%). See Section III for a comprehensive discussion of the evidence that supports these figures.

In the third scenario, we replace payment deferral and the Flex Mod with a traditional market-rate modification, which cures the borrower's delinquency by adding missed payments to the loan balance, resetting the term to 30 years, and setting the interest rate to the prevailing mortgage rate. Borrowers who accept market-rate modifications but redefault either self-cure or are evaluated for disposition. Depending on the difference between the loan's existing note rate and the prevailing mortgage rate, a market-rate modification may increase or reduce the monthly P&I payment. Today, with the mortgage rate above 6.50% and substantially above the note rate on nearly all SDQ loans, a market-rate modification results in an increase in monthly P&I payment and high redefault and disposition rates.

GSE Savings at the Portfolio-Level

The current home retention alternatives create substantial savings at the GSE portfolio level, as noted in Finding 2 and shown in Table 2. Even today, with the GSEs' SDQ rates at very low levels, applying our methodology to the 96,450 SDQ GSE loans outstanding as of February 2025 yields substantial savings: the GSE payment deferral and Flex mod save the GSEs $1.7 billion by averting 34,000 dispositions. The savings relative to a market-rate modification are also compelling: the current GSE home retention programs save the GSEs $1.1 billion by averting about 23,000 dispositions.

Table 2. Portfolio-Level GSE Savings created by Current Home Retention Programs.

Portfolio-Level Savings from Current Home Retention Programs	Current SDQ Rate	COVID Peak SDQ Rate
GSE-backed Loans (millions)	30.9	30.9
SDQ Rate	0.31%	3.32%
SDQ Loan Count	96,450	1,026,743
Relative to no Home Retention Options		
GSEs' Savings ($ billions)	1.7	17.6
Avoided Foreclosures	34,074	362,728
Relative to Market-Rate Modifications		
GSEs' Savings ($ billions)	1.1	11.8
Avoided Foreclosures	22,947	244,282

Sources: Recursion, Fannie Mae, and author's calculations.

The savings generated by the GSEs' current home retention programs are most pronounced during periods of economic or market stress, of course, when the SDQ rate increases. For example, in the event of a sharp economic downturn that produces a 3.32% SDQ rate for GSE loans last seen at the height of the COVID-19 pandemic, the current GSEs' programs would avoid about 363,000 dispositions, saving the GSEs $17.6 billion.[6] If the economic downturn were accompanied by a drop in the mortgage rate to 4.00%, the savings from the GSEs' home retention programs would increase to $26.2 billion.[7]

Similarly, the savings from the current GSE home retention alternatives relative to a market-rate modification are greater in the peak pandemic scenario—avoiding about 244,000 dispositions, saving the GSEs $11.8 billion.

Most importantly, as noted in Finding 3, the savings created by the GSE payment deferral and Flex Mod, relative to dispositions and market-rate modifications, persist in a wide variety of market scenarios. We test the sensitivity of our results to changes in our model parameters in the Appendix and find that unless loss severity falls to historically low (and likely unrealistically) levels (11%), the GSE home retention programs still generate savings for the GSEs. Similarly, the savings remain in place unless mortgage rates quickly rise above 9.50% before turnover results in higher note rates on the loans in the GSE portfolios.

Section II: The Cost and Performance of Loss Mitigation Solutions

Next, we compare the cost and performance of each solution within our three loss mitigation scenarios, as shown in Table 3.[8] Using a representative portfolio of SDQ GSE

[6] Assuming all other model inputs and the existing stock of GSE loans are fixed and that the 3.32% SDQ rate for Fannie Mae in August 2020, as per display, would apply to Freddie Mac too. As per Foreclosure Prevention, Refinance, and FPM Report - November 2024 there are about 31 million GSE loans outstanding.

[7] Assuming the GSEs' borrowing cost also fell to 2.00% while all other model inputs are held fixed.

[8] The figures in Table 1 are derived from the expected costs in Table 3 assuming 60% of SDQ GSE borrowers state that they can resume their original payment while 40% do not and are provided payment reductions to make their mortgages affordable. The figures in Table 2 are derived from the expected costs in Table 3 using the same take-up rates after applying an 8% non-response rate and assuming that 60% of non-responders transition from default to disposition. For

loans described in the Appendix, we calculate the average cost, principal and interest (P&I) reduction delivered (when applicable), expected redefault rate, and expected disposition rate for payment deferral, Flex Mod, disposition, and a market-rate modification. As noted above, the current GSE loss mitigation solutions are applied in hierarchical order according to the cost for the GSEs, from least costly (payment deferral) to most costly (disposition).

All other factors held equal, SDQ borrowers who state that they can resume their monthly payment would be expected to have lower redefault rates than borrowers who do not. Therefore, in the market-rate modification scenario, we calculate costs, redefault rates, and disposition rates separately for these two groups of borrowers and compare the results for the former group to payment deferral and the latter group to the Flex Mod. Additional details are provided in the Appendix.

Table 3. Expected Cost, P&I Reduction, and Redefault and Disposition Rates.

Loss Mitigation Scenarios	Expected Cost per SDQ Loan	Average P&I Reduction Delivered	Expected Redefault Rate	Expected Disposition Rate
1. Payment Deferral	$16,208	N/A	30%	18%
Flex Mod	$37,356	19%	45%	27%
2. Disposition	$43,337	N/A	N/A	60%
3. Market-Rate Modification (Payment Resumption)	$33,684	-26%	70%	42%
Market-Rate Modification (Payment Reduction)	$38,933	-26%	81%	49%

Source: Author's calculations.

The figures in Table 3 support Finding 4, that payment deferrals generate loan reperformance at a high rate and cost less than half the cost of dispositions and market-rate modifications. For the average SDQ GSE loan, payment deferral costs 63% less than a disposition and cuts the SDQ loan disposition rate by 70%. Similarly, payment deferral costs 52% less than a market-rate modification provided to borrowers who indicate they can afford to resume their original monthly payments and cuts the SDQ loan disposition rate by 57%.

As detailed in the Appendix, because the cost to the GSEs of financing the deferred amount is small, most of the cost of payment deferral is due to redefaults, and therefore the cost of "unnecessary" payment deferrals is modest. While there is no evidence of this occurring, even if the average SDQ GSE borrower were to take out forbearance without the presence of a financial hardship and then resolved their delinquency using a payment deferral, because the probability of redefault in this case is zero, the cost to the GSEs would be just $3,665 or 1.4% of the unpaid principal balance (UPB) at default.[9] And such an action would not be costless to the borrower as their missed payments would harm their credit score.

the market-rate modification scenario, we assume 25% of SDQ borrowers do not respond, of whom 60% transition to disposition.

[9] Calculated as deferred amount x the GSEs' annual borrowing cost x loan duration + payment deferral incentive payment = $12,330 x 4.35% x 5.9 years + $500.

Similarly, the figures in Table 3 support Finding 5, showing that Flex Mods generate payment reductions, and therefore loan reperformance, much more effectively than market-rate modifications. Today, with note rates on most SDQ loans well below the prevailing mortgage rate, the Flex Mod generates a P&I reduction of 19% for the average SDQ loan. Moreover, the Flex Mod reaches the 20% P&I reduction target for 86% of SDQ GSE loans. In contrast, a market-rate modification *increases* the P&I payment for the average SDQ loan by 26% and *increases* the P&I payment for 83% of existing SDQ GSE loans.

As a result, the Flex Mod has a much lower expected redefault (45%) and disposition (27%) rate for SDQ loans compared to a market-rate modification. Given that a market-rate modification increases the P&I payment for the average SDQ loan, it results in an 81% redefault rate and a 49% disposition rate.[10] Moreover, as we describe in the Appendix, the expected cost of Flex Mods will decrease relative to a market-rate modification as mortgage rates fall, which leads us to conclude that the Flex Mod is more effective than a market-rate modification across all interest-rate environments.

It is important to note that we likely underestimate the savings generated by the Flex Mod because we assume all reperforming loans are either sold or marked-to-market on the GSEs' balance sheet at the hypothetical sale price. In addition, over time, the cost of Flex Mods will decline relative to market-rate modifications, as the GSE portfolios turn over and loans with low note rates are replaced by loans with higher note rates.

Between payment deferral and the Flex Mod, the GSEs have optimized their home retention programs to be cost-effective in a wide variety of economic scenarios, as was evidenced during the pandemic. The programs will provide substantial benefits across economic cycles, and the resulting program stability will avoid additional implementation costs going forward.

As per Finding 6, we recommend the GSEs consider 2 steps to improve the cost-effectiveness of their home retention programs. First, given current home equity levels, we recommend the GSEs enhance their early intervention actions by using their automated valuation models (AVMs) to provide SDQ borrowers with estimates of their house value and home equity. This information may motivate some SDQ borrowers to find a home retention solution more quickly, to keep their home (and preserve their equity), leading to additional GSE savings. To the extent the information spurs other SDQ GSE borrowers to complete a market sale, it would also create additional savings for the GSEs. We discuss this opportunity in further detail in Section III.

Second, the GSEs should consider reordering the steps of the Flex Mod to put term extension before interest rate reduction, because term extension has little cost to the

[10] As described in the Appendix, the Flex Mod retains its cost and loan reperformance advantage over a market-rate modification with a 40-year term and modified interest rate set to PMMS + 0.50%.

GSEs. As the GSE portfolios turn over or if the mortgage rate falls, making this adjustment will reduce the cost of the Flex Mod. We discuss this recommendation further in the Appendix.

Section III: Scenario Outcomes and Model Assumptions

In this section, we first trace how our assumptions for model parameter values under each scenario (the current GSE home retention programs, only dispositions, and market-rate modifications) lead to three final outcomes: reperformance, self-cure, or disposition. We then provide the rationale to support our assumptions for take-up rates, redefault rates, rates of transition from default to disposition, and loss severity, which have been calibrated to historical values and chosen to represent through-the-economic cycle values.

Next, we consider the interaction between self-cures, equity, and market sales, and discuss how the GSEs might further reduce their costs by providing SDQ borrowers with information to estimate their equity and assess the viability of a market sale.

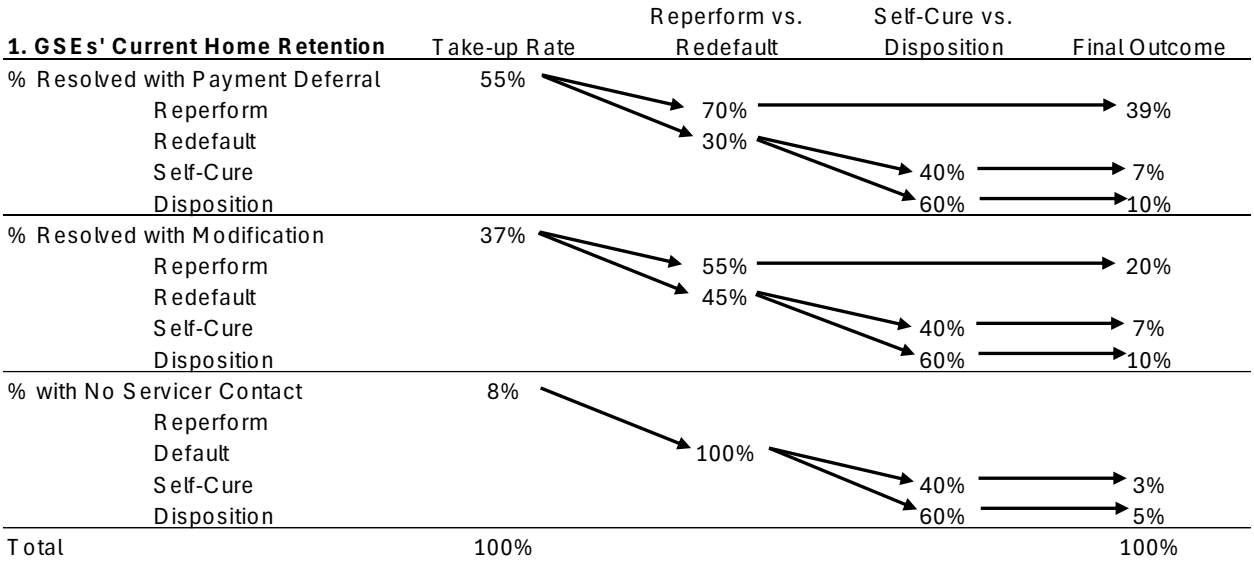
Final Outcomes for SDQ Borrowers: Reperformance, Self-Cure, or Disposition.

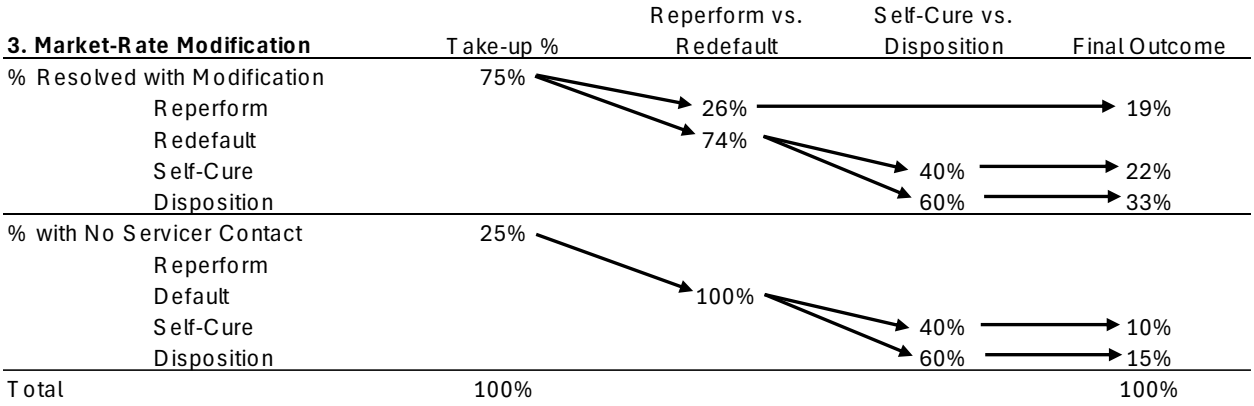
We summarize how our assumptions for take-up rates, redefault rates, and rates of transition from default to disposition lead to reperformance, self-cure, or disposition in Table 4.

We traverse each path in Table 4, taking the product of the relevant rates as we move from left to right. Then, by summing the outcome percentages in the last column for each scenario, we determine the final outcomes for each scenario shown at the bottom of Table 4.

Based on the results in Table 4, we confirm that, while a borrower who self-cures without using a home retention alternative creates the least cost per loan for the GSEs amongst the outcomes in Table 4, **the increase in dispositions and associated losses caused by reducing or removing home retention alternatives will far outweigh the savings induced by more self-cures.**

Table 4. Paths and Final Outcomes for SDQ GSE Borrowers under three Loss Mitigation Scenarios.





Final Outcomes	Reperform	Self-Cure	Disposition	Total
1. Current Home Retention Program	59%	16%	25%	100%
2. No Home Retention Options		40%	60%	100%
3. Market-Rate Modification	19%	32%	48%	100%

Source: Author's calculations.

Comparing the final outcomes for the three scenarios in Table 4 shows the significant benefit of home retention on reperformance and the disposition rate for SDQ loans. Under the current GSE home retention programs, of final outcomes, we expect 59% of SDQ borrowers to reperform, 16% to self-cure, and 25% to move to disposition. In contrast, with no home retention and disposition as the only alternative, take-up rate and redefault rates

are not relevant and the paths and outcomes are straightforward: we expect 60% of SDQ GSE borrowers would face disposition and 40% would self-cure.

In the market-rate modification scenario, we expect 19% of SDQ borrowers to reperform, 32% to self-cure, and 48% to move to disposition. Because the market-rate modification results in a payment increase for SDQ GSE borrowers, the non-response rates (25%) and redefault rates (74%) are high, which leads to the 23 percentage point increase in disposition rate relative to the current home retention programs.

We can test our assumptions for redefault rates and transition rates from default to disposition against a study of Fannie Mae loans covering 2004 to 2013 that finds that providing a modification to SDQ borrowers, after controlling for other factors, caused a reduction in their disposition rate of 41 percentage points relative to SDQ borrowers who were not provided with a modification.[11] As shown in Table 4, our assumptions lead to a 35 percentage point gap between the current GSE home retention programs and loss mitigation that only includes disposition, which suggests our assumptions are conservative and we may be underestimating the savings provided by the GSE home retention programs.

In sum, the current GSE home retention programs lead to a greater proportion of lower-cost outcomes than the other scenarios: 75% of SDQ loans reperform or self-cure, nearly double the rate under no home retention options (40%) and 47% higher than the rate with a market-rate modification (51%).

Assumed Model Parameter Values

Below we provide our model inputs for take-up rates, redefault rates, transition rates from default to disposition, and loss severity, and describe the historical data on which they are based.

Take-up Rates: the results in Table 1 assume 60% of SDQ borrowers state that they can resume their original payment and use payment deferral and 40% do not; these latter borrowers who require a payment reduction use a Flex Mod. Since the payment deferral was introduced in 2020, the take-up rate has been higher: 74% of completed home retention actions have been payment deferrals and 21% have been Flex Mods.[12] However, take-up rates of payment deferrals were significantly higher (about 86%) in 2020 and 2021 than in 2022 – 2024Q3 (52% on average), so we choose 60% for our portfolio-level analysis to better reflect a through-the-economic-cycle take-up rate for payment deferrals. The remaining 40% of SDQ borrowers take a Flex Mod.

[11] As described in Section 5.1 of w33692.pdf.

[12] The remaining 5% of completed home retention actions were repayment plans, as described in Foreclosure Prevention & Refinance Report - April 2021, FPRR-3Q2024.pdf, and https://www.fhfa.gov/document/FPR-FPM-Report-November-2024.pdf.

We apply these same take-up rates to the market-rate modification scenario, assuming that 60% of borrowers state they can resume their original monthly payment, whereas 40% do not and need a payment reduction to make their mortgage affordable. While both sets of borrowers will receive a market-rate modification in this scenario, their expected redefault rates will differ, as described in the Appendix.

For the portfolio-level results presented in Table 2, we assume 8% of SDQ borrowers will be unresponsive to the current home retention alternatives, which matches the borrower non-response rate at the conclusion of COVID-19 forbearance, as described in the Appendix. Given our assumption that 8% of SDQ borrowers will be unresponsive, we adjust our portfolio-level take-up rates to 60% x 92% = 55% for payment deferral and 40% x 92% = 37% for the Flex Mod.

For the market-rate modification portfolio-level results, we use a non-response rate of 25%, so the take-up rate is 75%. A market-rate modification will result in a higher monthly payment for loans that have a note rate below the prevailing mortgage rate. This is the case for most loans today and, over the long run, there will always be some fraction of the SDQ GSE portfolio for which this is true. Therefore, across economic cycles, we expect that a higher percentage of SDQ borrowers will be unresponsive to a market-rate modification because it raises their monthly payment.

As we show in the Appendix, our portfolio-level savings hold even at higher non-response rates. In fact, the GSEs' current home retention alternatives are at worst break-even; if no SDQ borrowers use them, they create no cost for the GSEs, of course.

Redefault Rates: for our analysis of the current GSE home retention programs, we set the probability of redefault to conservative (high) levels: our probability of payment deferral redefault is 30% and Flex Mod redefault is 45%.

Our assumed redefault rates are considerably higher than recent experience. For example, mortgage industry data as of April 2025 shows that 16% of GSE borrowers who received a payment deferral in 2020 or later have missed one or more payments and 24% of GSE borrowers who received a Flex Mod in 2020 or later have missed one or more payments.[13] Moreover, data released by the Federal Housing Finance Agency (FHFA) shows that 19% of Flex Mod recipients fall 60+ days behind within 12 months of the modification.[14] Moreover, our definition of redefault is three or more missed payments and, since many borrowers who fall one or two payments behind do not miss a third payment, we would need to adjust the industry and FHFA figures *lower* to reflect our definition of redefault, which makes our settings even more conservative.

[13] Source: The Mortgage Bankers Association (MBA) Monthly Loan Monitoring Survey, May 2025.
[14] Source: FPRR-3Q2024.pdf.

However, in light of the substantial additional government support borrowers received during the pandemic, which may not reflect the steady-state government response to every period of increased delinquency, we use higher through-the-cycle redefault rates for the payment deferral (30%) and Flex Mod (45%). The 30% payment deferral redefault rate is consistent with the redefault rate we use for market-rate modification recipients who indicate they can afford to resume their original monthly payment. For this set of borrowers, if a market-rate modification results in no payment change, the redefault function returns a redefault rate of 34%. Similarly, the 45% Flex Mod redefault rate is consistent with the function we use to calculate redefault rates for borrowers who need payment reduction and receive market-rate modifications, which is based on modification performance following the Great Recession. For a 20% P&I reduction, the function returns a 47% redefault rate. Both redefault functions are described in more detail in the Appendix.

Transition Rates from Default to Disposition: not every borrower who misses three or more mortgage payments ends up in disposition, as some borrowers self-cure. To account for these transitions properly, we must make assumptions about the expected transition rate, i.e., the probability of defaults transitioning to disposition.

We assume a probability of disposition given default of 60%. We assume the rest of defaults self-cure, which results in a self-cure probability of (1 – 60%) = 40%. We use the same 60% probability of disposition given default in the scenario in which no home retention alternatives are available, for borrowers who are unresponsive, and for borrowers who use a home retention alternative but redefault.

As one would expect, the transition rate from default to disposition varies with economic conditions—during periods of economic recession and house price depreciation, a higher proportion of defaults will end in disposition, whereas during periods of economic expansion and home price appreciation (HPA), a lower proportion of defaults will end in disposition.

Research provides several empirical measures of the transition rate from default to disposition. For example, analysis of Home Affordable Modification Program (HAMP) modifications that redefaulted and were fully resolved, which took place after a period of considerable house price depreciation, finds a transition rate from redefault to disposition of 69%.[15]

A study of GSE loans originated between 1999 and 2019Q2 that reached 180 days delinquent indicates that between 66% and 73% ended in disposition.[16] However, our default definition is 90 days delinquent, and one would expect a higher disposition rate for loans that reach 180 days delinquent compared to loans that reach 90 days delinquent. When the analysis is extended to include the pandemic, covering originations from 1999

[15] Source: ganong_noel_liquidity_vs_wealth_2020_appendix.pdf.
[16] Source: Housing Finance Chartbook.

through 2024, it shows a disposition rate of between 43% and 50%.[17] However, the pandemic period was marked by mortgage forbearance, a lengthy foreclosure moratorium, a significant amount of fiscal stimulus, and sharp HPA, all of which reduced disposition rates and make the figures from the extended analysis less representative of the long-run probability of disposition given default.

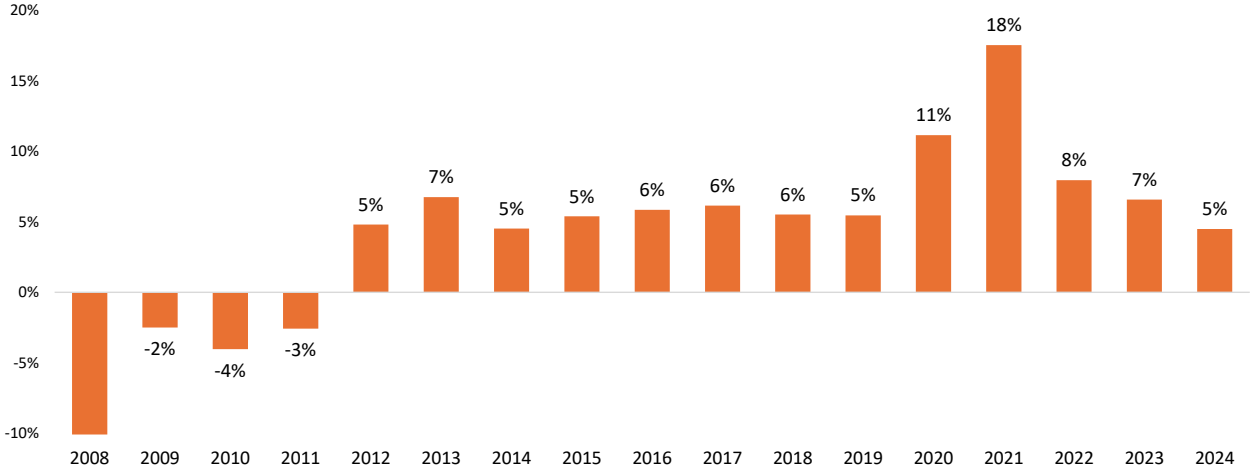
Based on the empirical measures described above, we choose a probability of disposition given default of 60%, which is between the long-term average for loans that reach 180 days delinquent in the updated analysis (43% - 50%) and the analysis that excludes the pandemic period (66% - 73%). Our 40% self-cure rate is at the upper end of the range implied by forbearance exit data, which is described in the Appendix. For loans that redefault after payment deferral, a Flex Mod, or a market-rate modification, we assume no subsequent home retention alternatives are provided. This is a conservative and simplifying assumption—borrowers who redefault after accepting payment deferral may be eligible for a Flex Mod that they may well be able to afford and would be less costly for the GSEs than disposition. However, we do not consider this outcome and instead assume that all payment deferral redefaults either self-cure (40%) or result in disposition (60%).

Loss Severity: we use the average Fannie Mae UPB-weighted loss severity of 28% from dispositions completed between January 2018 and June 2024 for all disposition outcomes.[18] As noted above, the Fannie Mae loss severity figures include not only foreclosures but also third party sales, short sales, deeds-in-lieu of foreclosure, and non-performing loan sales, and have been reduced by any benefits the GSEs received from private mortgage insurers.[19]

While one might expect a high correlation between HPA and loss severity, for the reasons described below, HPA alone does not reduce loss severity on dispositions beyond a certain level. For context, Figure 1 shows annual HPA (or depreciation) since 2008. House price appreciation remained stable between 2012 and 2019, increased sharply in 2020 and 2021, and has since returned to pre-pandemic levels.

[17] Source: Housing Finance Chartbook.
[18] Source: Statistical Summary Tables.
[19] Ibid. The GSEs can sell NPLs to the private sector, as per Non-Performing and Reperforming Loan Sale Requirements and Enterprise Non-Performing Loan Sales Report - June 2024. Because the gains or losses from NPL sales are included in the loss severity figure provided by Fannie Mae, we need not consider NPL sales as a separate outcome in our analysis.

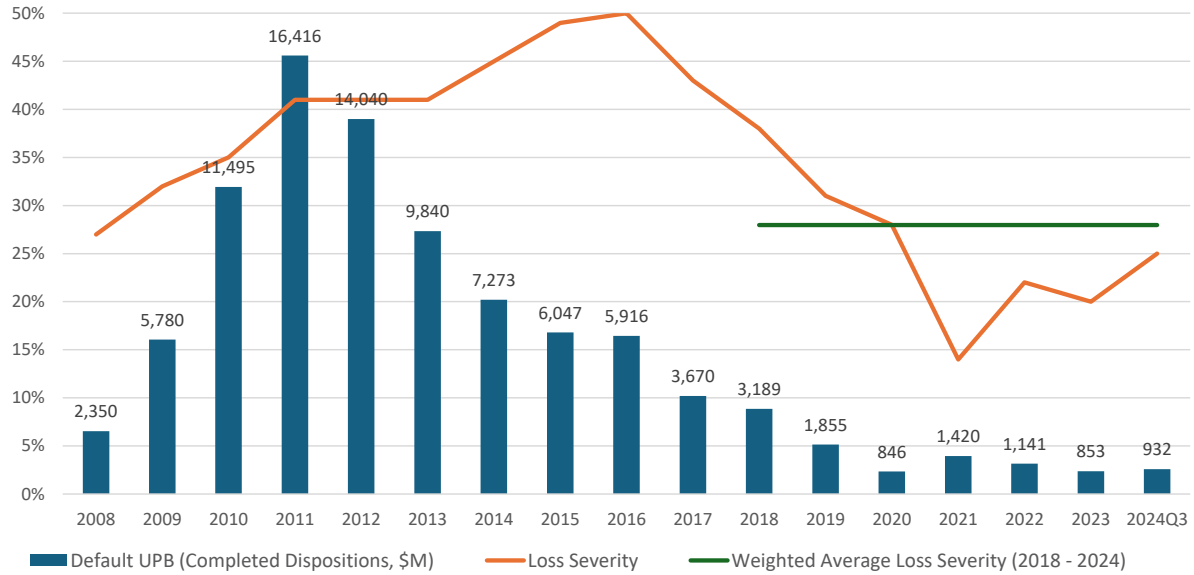
Figure 1. Annual Change in FHFA Purchase-Only House Price Index (Seasonally Adjusted).



Source: [FHFA House Price Index® Datasets | FHFA] and author's calculations.

Figure 2 shows the defaulted UPB of Fannie Mae dispositions and loss severity **by year of disposition**. Dispositions have dropped dramatically since peaking in 2011 and have now stabilized at low levels. Loss severity has also fallen since peaking at 50% in 2016 but, despite the strong HPA of 2020 and 2021, it increased to 25% in 2024.

Figure 2. Fannie Mae UPB at Default and Loss Severity for Completed Dispositions by Disposition Year.



Source: [Statistical Summary Tables] and author's calculations

From Figure 2, it is evident that the double-digit HPA of 2020 – 2021 had only a short-term impact on loss severity, in 2021. There are two reasons why HPA alone does not reduce loss severity on dispositions beyond a certain level.

First, any benefit of a short period of strong HPA on loss severity will be short lived. While it may seem obvious, a period of sharp HPA can only reduce loss severity on loans originated **prior to the run-up in house prices**. In other words, the sharp HPA experienced in 2020 – 2021 shown in Figure 1 does nothing to reduce the loss severity on a loan originated in 2023. If anything, a period of strong HPA makes loss severity on loans originated after the period worse because, as a result of the strong HPA, loan amounts will be larger, reflecting higher house prices.

We can illustrate the short-term impact of the 2020 – 2021 HPA gains on loss severity by examining one component of the Fannie Mae loss severity data: proceeds from dispositions, expressed as a percentage of UPB at default. An increase (decrease) in sales proceeds will decrease (increase) loss severity. Examining sales proceeds on dispositions **by loan origination year** rather than disposition year tells the story: For dispositions completed in the first half of 2024, sales proceeds were highest for 2018 originations, at 101%.[20] In contrast, sales proceeds for more recent originations show none of the benefit of the pandemic period HPA—sales proceeds for 2021 (89%), 2022 (85%), and 2023 (89%) originations are much lower and in line with those for 2010 (87%) and 2011 (90%) originations.[21]

Second, the influence of a sharp HPA period on loss severity naturally fades over time because GSE portfolios turn over and mortgage defaults are typically more concentrated in recent originations. Portfolio turnover, which is driven by refinances, house sales, and mortgage payoffs, shows that few borrowers remain in their mortgage for more than 10 years. As a result, 60% of the outstanding UPB in the GSE portfolios was originated in 2021 or later.[22] Moreover, while 32% of the GSE portfolio was originated between 2022 and today, these originations account for 44% of defaults.[23]

Since dispositions peaked in 2011, foreclosure timelines have steadily increased and, all other things held equal, reducing foreclosure timelines would reduce loss severity. However, the timeline extension has caused only a modest increase in loss severities, so it is unlikely that reducing foreclosure timeliness will reduce the need for the GSE home retention programs. For example, the average number of days between default notice and foreclosure sale increased from 350 days in 2011Q4 to 671 days in 2025Q1, an extension of about 10.5 months.[24] Research indicates that extending foreclosure timelines by 10.5 months would cause an increase in loss severity of between 4.5 and 7 percentage points.[25]

[20] Source: Statistical Summary Tables.
[21] Ibid.
[22] Weighted by UPB. Source: Recursion as of February 2025.
[23] Ibid.
[24] Source: https://www.attomdata.com/news/market-trends/foreclosures/q1-and-march-2025-foreclosure-market-report/.
[25] Source: Mortgage Loss Severities: What Keeps Them So High?

Assuming reducing foreclosure timeliness to 2011 levels would have the opposite and maximum effect, it would reduce our through-the-cycle loss severity estimate from 28% to 21%, but the per-action savings from the GSE home retention programs would remain substantial: $12,000 relative to disposition and $6,500 relative to market-rate modifications. Foreclosure timelines are largely driven by state regulations, and in states where foreclosure timelines have extended substantially more than the national average, reducing foreclosure timelines may lead to a more material reduction in loss severity.

In the Appendix, we show that our estimates of the savings from the current GSE home retention programs persist unless the loss severity rate drops to 11%. Given the considerations noted above, it seems unlikely that the GSEs' loss severity would *average* 11% across economic cycles.

Home Equity and Market Sales

Today, due to pandemic-induced HPA, a greater percentage of SDQ GSE borrowers may have sufficient equity to voluntarily sell their houses and self-cure, avoiding the use of loss mitigation altogether; this opportunity is more significant than is typical across more traditional economic cycles. Based on state-level HPA and a reasonable estimate of transaction costs, we can roughly approximate that at least 85% of SDQ GSE borrowers today would be able to retain some positive equity after a sale, suggesting a house sale may be a viable alternative to home retention.

Given current home equity levels, as per Finding 6, we recommend the GSEs enhance their early intervention actions by using their automated valuation models to provide SDQ borrowers with an approximate value for their home that, when paired with their unpaid loan balance, would provide a rough estimate of home equity.[26] This information may motivate some SDQ borrowers to contact their servicer to find a home retention solution that works for them so they can keep their home (and equity), leading to additional GSE savings. To the extent the information spurs other SDQ GSE borrowers to skip home retention entirely and self-cure using a market sale, it would also create additional savings for the GSEs.

It is important to note that, despite positive equity, there may be many reasons why a market sale is not a viable outcome for some SDQ GSE borrowers, raising the importance of cost-effective home retention programs. Selling a house and moving takes time, has an uncertain outcome, and has costs that cannot be covered using the sales proceeds. Borrowers under financial duress may have neither the time nor resources to contemplate a market sale. Moreover, many homeowners today have a mortgage with a well-below-market note rate and, even with a substantial amount of equity for a downpayment, may have difficulty finding a suitable home with a mortgage payment they find affordable. It is

[26] As discussed on p. 26 of AEI Housing Market Indicators, March 2025 | American Enterprise Institute - AEI.

also likely that, given the negative impact of mortgage default on their credit scores that SDQ borrowers will have already experienced, many will have difficulty qualifying for a mortgage at all. Taken together, these factors lead to the counterintuitive conclusion that while HPA does create positive home equity that is helpful, positive equity alone may not provide sufficient reason for a borrower to pursue a market sale. Still, recent research finds that positive equity foreclosures are surprisingly common, so borrowers should be made aware of this alternative.[27]

Section IV: Conclusion

The purpose of loss mitigation is to minimize the number of defaults that transition to foreclosure and the related losses. Our analysis shows that, within loss mitigation, the GSE home retention programs, which include payment deferral and the Flex Mod, generate loan reperformance in a cost-effective manner and therefore enable the GSEs to avoid the high cost of dispositions.

We estimate that each disposition today costs the GSEs about $72,000 on average. In that context, the GSEs would suffer considerable financial losses if they were to eliminate payment deferral and the Flex Mod or replace them with a market-rate modification. After accounting for self-cures and post-intervention redefaults, every home retention action that the GSEs complete saves them $19,000 compared to a disposition and $11,000 compared to a market-rate modification.

The more dispositions these programs prevent, the more the government saves: at today's low rates of serious delinquency, the GSE home retention programs will save $1.4 billion by averting 29,000 dispositions on average. Should the serious delinquency rate rise to the COVID-19 pandemic high, the GSE would save $14.7 billion by averting about 304,000 dispositions on average.

It is important to emphasize that payment deferrals and Flex Mods generate loan reperformance *regardless of the relationship between loan note rates and the prevailing mortgage rate*. As a result, savings created by the GSE home retention programs relative to dispositions and market-rate modifications persist unless the mortgage rate quickly rises above 9.50% before the GSE portfolios turn over. Similarly, the savings persist unless loss severity falls to a historically low and likely unrealistic 11%. As we have shown, periods of strong house price appreciation do not reduce loss severity over the long run.

And we offer two recommendations for how the GSEs could improve the cost-effectiveness of their home retention programs. First, by using their AVMs to provide delinquent

[27] Source: What Triggers Mortgage Default? New Evidence from Linked Administrative and Survey Data by David Low :: SSRN.

borrowers with a home equity estimate and second by re-ordering the Flex Mod steps to put term extension ahead of interest-rate reduction.

Dispositions are necessary when a home is abandoned, a delinquent borrower fails to engage with their servicer, or the borrower's financial circumstances deteriorate beyond a certain point. But our findings make clear that by reducing the risk of disposition through their home retention programs, the GSEs save the government billions of dollars.

Appendix

In this Appendix, Section A1 provides a detailed description of the calculations used to estimate the expected cost of dispositions, payment deferrals, Flex Mods, and market-rate modifications. Section A2 describes the functions we use to calculate the prices and durations of mortgage loans, which are inputs to our cost calculations. Section A3 presents the function we use to estimate the causal impact of changes in monthly payment on subsequent default rates. Section A4 details our sensitivity analysis and shows that our results are not determined solely by our choice of model parameter values.

Section A1: Calculating the Cost of the Current and Potential GSE Home Retention Alternatives.

In this section, we present the detailed calculations we use to develop our estimates for the cost of the current GSE home retention alternatives, dispositions, and market-rate modifications. Using a set of 20 representative loans as a proxy for the GSE SDQ portfolio, we calculate the expected cost of disposition, payment deferral, a Flex Mod, and a market-rate modification for each loan. The GSEs' cost under each alternative is then the portfolio-weighted sum across all 20 loans.

Representative GSE SDQ Loan Portfolio

To conduct our cost analysis, we first construct a representative portfolio of SDQ GSE-backed loans.[28] We group SDQ GSE loans by origination year and then build a portfolio comprised of 20 loans with terms that match the average note rate, loan amount, LTV at origination, and MTMLTV of SDQ GSE loans for each origination year between 2015 and 2024.[29] For each of the 10 origination years we use 2 representative loans—one 15-year mortgage and one 30-year mortgage. Collectively, these 20 loans represent 96% of the UPB of SDQ GSE-backed loans as of February 2025 (the remaining 4% having origination years prior to 2015). For each representative loan, we calculate the percent of the SDQ portfolio it represents, the monthly P&I payment, the number of months from origination to default, and the UPB at default. UPB at default (the loan balance after the last made payment) is calculated by amortizing the original loan amount using the note rate, term, and months from origination to default of each loan.

The details of the 20 loans are shown in Table A1. Thirty-year mortgages comprise 91% of the SDQ GSE portfolio. Recent vintages dominate, as 78% of the SDQ portfolio is composed of mortgages originated between 2020 and 2024.

[28] All loan data is as of 2/1/25 and sourced from Recursion.
[29] MTMLTV is computed by Recursion using FHFA's state-level purchase-only house price index (non-seasonally adjusted) applied to the ratio of original loan amount / origination LTV.

Table A1. Terms of the 20 Representative SDQ GSE Loans.

Origination Year	2015	2015	2016	2016	2017	2017	2018	2018	2019	2019
Term (years)	15	30	15	30	15	30	15	30	15	30
Weighted % of SDQ Portfolio	0.4%	2.0%	0.6%	2.8%	0.6%	3.5%	0.4%	4.0%	0.5%	5.2%
Origination Loan Amount	136,450	192,511	153,325	207,881	148,651	202,631	137,988	195,917	165,130	228,963
Note Rate	3.737%	4.326%	3.414%	4.044%	3.840%	4.452%	4.408%	4.966%	3.883%	4.404%
LTV at Origination	69%	80%	68%	80%	68%	81%	68%	83%	69%	82%
Monthly P&I Payment	991	956	1,090	998	1,088	1,021	1,049	1,048	1,212	1,147
Months from Origination to Default	108	108	96	96	84	84	72	72	62	62
MTMLTV	16%	32%	18%	35%	22%	39%	26%	43%	31%	46%
UPB at Default	63,858	158,042	81,311	174,265	89,779	176,156	93,389	176,095	118,700	207,646
T&I as a % of P&I	64%	64%	61%	61%	59%	59%	59%	59%	56%	56%
Monthly T&I Payment	634	611	668	612	639	600	616	615	682	645

Origination Year	2020	2020	2021	2021	2022	2022	2023	2023	2024	2024
Term (months)	15	30	15	30	15	30	15	30	15	30
Weighted % of SDQ Portfolio	1.1%	10.5%	2.6%	22.1%	1.6%	21.2%	0.4%	9.4%	0.1%	2.7%
Origination Loan Amount	201,885	273,002	212,234	301,376	213,330	320,825	212,529	318,350	215,789	319,161
Note Rate	2.938%	3.314%	2.699%	3.262%	4.002%	5.124%	6.335%	6.772%	6.845%	6.980%
LTV at Origination	69%	82%	66%	79%	66%	79%	63%	82%	63%	81%
Monthly P&I Payment	1,388	1,198	1,435	1,314	1,578	1,747	1,832	2,070	1,921	2,119
Months from Origination to Default	52	52	40	40	27	27	15	15	10	10
MTMLTV	35%	50%	42%	58%	50%	68%	55%	75%	60%	79%
UPB at Default	152,380	248,222	172,193	280,515	188,885	310,068	201,474	314,091	208,709	316,464
T&I as a % of P&I	54%	54%	52%	52%	39%	39%	30%	30%	28%	28%
Monthly T&I Payment	747	645	739	677	614	679	547	618	542	598

Source: Recursion and author's calculations.

To estimate the T&I payments for each representative loan shown in Table A1, we use data that represents the current T&I payment as a percentage of total mortgage payment (P&I + T&I, or PITI), as shown in Table A2. We make the simplifying assumption that T&I as a percentage of P&I is the same for 15-year and 30-year loans originated in the same year.

Table A2. T&I as a Percentage of T&I and PITI by Origination Year.

Origination Year	T&I (% of PITI)	T&I (% of P&I)
2005	32%	47%
2006	30%	43%
2007	33%	49%
2008	36%	56%
2009	38%	61%
2010	39%	64%
2011	40%	67%
2012	40%	67%
2013	40%	67%
2014	39%	64%
2015	39%	64%
2016	38%	61%
2017	37%	59%
2018	37%	59%
2019	36%	56%
2020	35%	54%
2021	34%	52%
2022	28%	39%
2023	23%	30%
2024	22%	28%

Source: Visual inspection of page six of ICE Mortgage Monitor - October 2024 and author's calculations.

Computing the Expected Cost of Disposition

For SDQ loans that don't receive a home retention alternative or that redefault after receiving a home retention alternative, we compute the expected cost of disposition as:

(1) *Expected Cost of Disposition = UPB at Default x Probability of Disposition Given Default x Loss Severity*

SDQ loans are by definition already in default. Therefore, when we calculate the expected cost of disposition for SDQ loans, we do not include a term that captures the probability of default in Equation (1) and in the equations that follow because it would always be 100%. As described in Section III, we set the probability of disposition given default to 60% and use a loss severity of 28%.

Using Equation (1), each default or redefault has an expected disposition cost = 60% x 28% = 16.8% of UPB at default. In the scenario where the GSEs have no home retention alternatives, our weighted-average UPB at default = $258,000, so the expected cost of disposition per SDQ loan is about $43,300.

Computing the Expected Cost of Payment Deferral

We compute the expected cost of payment deferral as:

(2) *Expected Cost of Payment Deferral = Expected Cost of Financing Deferred Amount + (Probability of Payment Deferral Redefault x Expected Cost of Disposition) + Incentive Payment*

where

(3) *Expected Cost of Financing Deferred Amount = Number of Missed Payments x (P&I + T&I) x GSE Annual Borrowing Cost x Duration of Loan x (1 - Probability of Payment Deferral Redefault)*

Payment deferral allows the borrower to repay arrearages to the GSEs at the payoff or maturity of their loan. The borrower does not pay interest on the deferred amount. Therefore, we model the GSEs' cost of providing payment deferral by assuming the GSEs would have to borrow the deferred amount to reimburse servicers for advancing missed P&I and T&I payments at the time the payment deferral becomes effective. Then, the GSEs would pay the GSE borrowing cost on the deferred amount until they are repaid by the borrower, at loan payoff or maturity.

In addition, we capture the cost to the GSEs from those borrowers who redefault after receiving a payment deferral and end up in disposition.

For each of our 20 loans, we assume that borrowers who use payment deferral have missed six monthly payments of both P&I and T&I, which is the maximum number of

payments permitted per use of the payment deferral. The monthly P&I and T&I for each loan is shown in Table A1.

The GSEs' annual borrowing cost is set to 4.35%, which is about the yield on the 10-year US Treasury Note.[30] The remaining duration of each loan is calculated based on the note rate and remaining maturity using a duration function that has been calibrated to prices of MBS observed on February 28, 2025, as described in Section A2.

Our weighted-average P&I = $1,458, T&I = $655, remaining loan duration = 5.9 years, and payment deferral redefault rate = 30%. Plugging these figures into Equation (3) results in an average expected cost of financing the deferred amount of $2,278.

We assume redefault is immediate, and therefore the expected cost of disposition is calculated using Equation (1) after substituting UPB at redefault for UPB at default.[31] Our weighted average UPB at redefault is $267,500, calculated as UPB at default (as shown in Table A1) plus the non-principal portion of the deferred amount. The expected cost of payment deferral redefaults is then $13,500. Adding the financing and disposition costs to the $500 incentive payment paid by the GSEs to mortgage servicers for each completed payment deferral brings the total expected cost of providing a payment deferral to about $16,280, or 6.3% of average UPB at default.

We are likely to overestimate the cost of payment deferral due to our assumptions. First, we assume all SDQ GSE borrowers who take payment deferral have missed the maximum six payments, while some may have missed fewer than six payments. Moreover, we assume all SDQ borrowers who are responsive have their delinquency resolved with payment deferral or a Flex Mod, whereas some SDQ borrowers will be able to repay missed payments in a lump-sum payment or through a short-term repayment plan, which are less costly to the GSEs. For delinquencies resolved through a lump-sum payment, the cost to the GSEs is small because the missed payments that the GSEs cover are only financed for a short period. For delinquencies repaid in a repayment plan, the GSEs' expected cost of financing the missed payment amount can be calculated by substituting the repayment plan term for the loan duration in Equation (3). Repayment plan terms are typically shorter than our average loan duration of 5.9 years, so the expected cost of a repayment plan would be less than a payment deferral.[32]

---

[30] As of 4/24/2025, sourced from U.S. 10 Year Treasury Note Price & News - WSJ | TMUBMUSD10Y.

[31] We make the simplifying assumption that redefault after payment deferral is immediate and therefore neglect the cost of financing the payment deferral between provision and disposition for redefaults. If, for example, borrowers redefaulted 2 years after taking payment deferral, the GSEs would incur an additional $330 in expected financing costs, which is too small to change our results.

[32] Since the payment deferral was introduced in 2020, repayment plans have constituted between 2% and 11% of completed home retention actions. Source: Foreclosure Prevention, Refinance, and FPM Report - November 2024. Repayment plan terms are typically 36 months or shorter. For example, Fannie Mae requires that a forbearance term plus repayment plan term cannot exceed 36 months and repayment plans that exceed 12 months must be approved by Fannie Mae. Source: Repayment Plan | Fannie Mae.

Computing the Expected Cost of a Flex Mod

To complete a Flex Mod, the GSEs purchase the SDQ loan out of the MBS pool, modify the terms to reach a 20% P&I reduction (if possible), and, if the modified loan is still current after a seasoning period, can generally sell the re-performing loan (RPL).

In calculating the cost of the Flex Mod for each representative loan, we use several additional inputs. We use a Freddie Mac Modification Interest Rate of 7.00%.[33] We compute prices of RPL sales using a Freddie Mac Primary Mortgage Market Survey (PMMS) Rate of 6.76% as an input to our loan pricing function, which has been calibrated to prices of MBS observed on February 28, 2025, as described in Section A2.[34]

We make two additional assumptions. First, we assume Flex Mod recipients have no pre-existing payment deferrals. Flex Mod rules dictate that any existing deferred payments should be capitalized into the UPB of the new loan. This is a money-saving step for the GSEs, as it converts zero-interest loan balances to interest-bearing loan balances. Given the low prevalence of existing payment deferrals, we set the amount of existing payment deferrals to zero for all 20 of our representative loans.

Even if we were to include existing payment deferrals, it would not change our results. According to FHFA data, only 4% (1.23 million out of 31 million) of GSE loans have a payment deferral.[35] Let's assume these borrowers each missed 12 PITI payments, the maximum number of missed payments that can be deferred. Based on our representative portfolio, 12 PITI payments are equivalent to 10% of UPB at default. If 4% of loans have a payment deferral equivalent to 10% of UPB at default, averaging the effect on each of the 20 representative loans in our GSE SDQ portfolio would be a payment deferral of 0.4% of UPB at default, which is too small to change our results.

Second, we assume that Flex Mod recipients have nine missed payments (P&I plus T&I) that need to be resolved, which aligns with a conservative interpretation of FHFA data on delinquency prior to receiving a Flex Mod. FHFA data for loan modifications and delinquency status over the last 14 months is shown in Table A3. For each delinquency status, we make a conservative assumption for the number of missed payments for the average loan with that delinquency status. For example, for the "current or missing" category, we assume the borrower has missed nine payments, whereas for the 60 – 89 days delinquent, we assume the borrower has missed three payments. We then calculate the weighted average to arrive at our estimate of nine missed payments for each Flex Mod recipient. As discussed in the Section A4, our results are relatively insensitive to the number of missed payments for the Flex Mod model input.

[33] Source: Freddie Mac Modification Interest Rate - Freddie Mac Single-Family as of February 28, 2025.
[34] Source: Mortgage Rates - Freddie Mac as of March 3, 2025.
[35] Source: Foreclosure Prevention, Refinance, and FPM Report - November 2024.

Table A3. Delinquency Status at Modification for Flex Mod Recipients, October 2023 – November 2024.

Delinquency Status at Modification	Loan Count	Assumed Delinquency (months)
Current / Missing	1,427	9
30 - 59 Days Delinquent	4,791	1
60 - 89 Days Delinquent	6,397	3
90 - 179 Days Delinquent	24,542	4
180 - 364 Days Delinquent	21,707	9
365+ Days Delinquent	13,490	24
Total	72,355	9

Source: Foreclosure Prevention, Refinance, and FPM Report - November 2024 and author's calculations.

Overall Cost of the Flex Mod: we compute the expected cost of a Flex Mod as:

(4) *Expected Cost of Flex Mod = Expected Cost of Carrying Loan on Balance Sheet – Expected Net Proceeds from RPL Sale + Expected Cost of Financing Deferred Principal + (Probability of Flex Mod Redefault x Expected Cost of Disposition) + Incentive Payment*

We assume all Flex Mod redefaults occur before the RPL is sold and that no further home retention alternatives are provided after redefault. Therefore, we only include the expected Flex Mod costs in the first three terms of Equation (4) for those borrowers who do not redefault; for those borrowers who do redefault, the cost of their failed Flex Mods is captured in the fourth term of Equation (4).

Expected Cost of Carrying Loan on Balance Sheet: the expected cost of carrying the delinquent loan on balance sheet is composed of interest paid on various borrowed amounts: the funds to purchase the loan out of the MBS pool, the funds to reimburse servicers for P&I and T&I advances, and the funds to make T&I payments while the loan is on balance sheet. These interest payments are offset by post-modification P&I payments received from the borrower, which the GSEs retain until the RPL is sold.

(5) *Expected Cost of Carrying Loan on Balance Sheet = (Interest Paid on Loan Buyout Amount + Interest Paid on Servicer Advances + Interest Paid on T&I Advances – Retained P&I) x (1 – Probability of Flex Mod Redefault)*

Since we assume the delinquent GSE loan remains in the MBS pool until the borrower has missed four payments, servicers must advance four payments of P&I to MBS bondholders and cover T&I shortfalls in the borrower's escrow account, as needed. We assume that the servicer must cover the entire T&I payment and T&I advances must be made monthly, which may overstate the amount of T&I advances actually required.

After the fourth missed payment, we assume the GSE buys the loan out of the pool, retains the loan on their balance sheet (B/S) until it can be modified and, if the borrower reperforms, sells the modified loan after 12 months. In all, the loan is on the GSE's balance sheet for 12 months. Note that there may be some variation in when each GSE buys the loan out of the pool and handles reimbursement of servicer P&I advances, but changing our assumptions does not have a material impact on our results.

Our assumptions lead to the following borrowed amounts and interest paid by the GSEs:

The GSE borrows the funds to purchase the loan out of the MBS pool at par, meaning the GSE buys the loan paying 100% of the outstanding UPB. As calculated below, the GSE will pay interest on these borrowed funds until they can be repaid using the proceeds from the RPL sale. The delinquent loan continues to amortize while in the MBS pool because the servicer is advancing P&I payments to the MBS bondholders, therefore:

(6) *Loan Buyout Amount = UPB at Default – Principal Paid in Servicer Advances*

and

(7) *Interest Paid on Loan Buyout Amount = Loan Buyout Amount x GSE Borrowing Rate / 12 x Months Loan is on B/S*

where

(8) *Months Loan is on B/S = (Number Missed Payments – GSE Buyout Month) + Months to RPL Sale*

When the loan is purchased out of the MBS pool, the GSE reimburses the servicer for the P&I and T&I advances made by the servicer during the initial delinquency period of four months. The GSEs pay interest on funds borrowed to reimburse servicers for making P&I and T&I advances and recover these funds when the RPL is sold from the loan buyout date to the RPL sale date

(9) *Servicer PITI Advances = 4 x (P&I Payment + T&I Payment)*

and

(10) *Interest Paid on Servicer Advances = Servicer PITI Advances x GSE Borrowing Cost / 12 x Months Loan is on B/S*.

The GSEs accrue interest on the loan buyout amount at the existing note rate while the loan is on balance sheet and before it is modified. We assume that the borrower misses all payments until their loan is modified.

(11) *GSEs' Accrued Interest = Loan Buyout Amount x Note Rate / 12 x (Number of Missed Payments – GSE Buyout Month)*

The servicer continues to cover any T&I shortfalls after the loan is bought out of the pool and before the modification becomes effective but, after the fourth missed payment, the servicer can apply to the GSE for reimbursement of T&I advances. Therefore, we assume the GSE covers T&I advances while the loan is on balance sheet and before the modification becomes effective (after which the borrower resumes making P&I and T&I payments). For simplicity, we assume the entire T&I payment must be covered by the GSE and that T&I advances are made monthly until the average of (Months to RPL Sale and Months Loan is on Balance Sheet), to account for the fact that the funds borrowed to make T&I advances accumulate over time. Our assumptions likely lead to an overstatement of the interest cost associated with advancing T&I payments.

(12) Amount Borrowed for T&I Advances = T&I Payment x (Number of Missed Payments – GSE Buyout Month)

and

(13) Interest Paid on T&I Advances = Amount Borrowed for T&I Advances x GSE Borrowing Rate / 12 x 0.5 x (Months to RPL Sale + Months Loan is on B/S).

The loan is then modified per the terms of the Flex Mod.[36]

(14) Capitalized UPB = Loan Buyout Amount + Servicer P&I Advances + Servicer T&I Advances + GSEs' Accrued Interest + Amount Borrowed for T&I Advances + Existing Deferred Principal

UPB at default and MTMLTV are shown in Table A1. We use these two terms to calculate the post-modification MTMLTV as:

(15) Post-Modification MTMLTV = Capitalized UPB / (UPB at Default / MTMLTV at Default)

The Modified Note Rate, Term, and Forborne Principal are then calculated based on the Post-Modification MTMLTV and the Flex Mod rules, which determines the Modified P&I Payment and the amount of forborne principal (if any).

(16) Modified Interest-bearing UPB = Capitalized UPB - Forborne Principal

Once the modification is effective, the borrower resumes making the (modified) P&I payments and T&I payments. While the GSE holds the loan on balance sheet, they retain these P&I payments, and the modified loan amortizes accordingly.

(17) Retained P&I = Modified P&I Payment x Months to RPL Sale.

We now have all of the components of Equation (5). For our weighted-average representative SDQ loan, the average expected cost of carrying the loan on balance sheet

[36] See Updates to Determining the Flex Modification Terms and Fannie Mae Flex Modification | Fannie Mae.

is $1,311 (or 0.5% of UPB at default), as the retained P&I on performing Flex Mods before RPL sale offsets most of the other carrying costs.

Expected Net Proceeds from RPL Sale: the net proceeds from the RPL sale reflect the amount received by the GSEs for the RPL sale, less the amounts that were borrowed by the GSEs and need to be repaid, which include funds to: purchase the loan, reimburse servicers for P&I and T&I, and to make T&I payments. Loans with principal deferred as part of the Flex Mod can be sold as RPLs, but the forborne principal amount is not part of the sale.[37]

(18) Expected Net Proceeds from RPL Sale = ((RPL Sale Price x UPB at RPL Sale) – (Loan Buyout Amount – Forborne Principal) – Servicer PITI Advances – Amount Borrowed for T&I Advances) x (1 – Probability of Flex Mod Redefault)

We estimate RPL sales prices based on the market price for a hypothetical UMBS with a similar maturity and WAC as the modified loan, as described in Section A2. The modified loan amortizes while on balance sheet, so we reduce the UPB accordingly.

(19) UPB at RPL Sale = Modified Interest-Bearing UPB – Principal Paid on Modified Loan for Months to RPL Sale

After using the equations in Section A2 to calculate the rate spread and RPL Sale Price for each loan, we have all of the components in Equation (18).

The average expected net proceeds from the RPL sale is a loss of about $12,400 (or 4.8% of UPB at default). This loss is the major cost driver of the Flex Mod and is caused by the difference in pricing between the loan buyout at par and the securitization of the RPL at current market prices; the average RPL sale price in our model is 90.07%. Note that we make the simplifying assumption that RPLs are either sold via securitization or are marked-to-market on the GSEs' balance sheet at the price at which they could be sold via securitization, and this makes our results conservative. The GSEs can choose to hold RPLs in portfolio until payoff or maturity and, to the extent that the loans perform, never realize the loss calculated above from an RPL sale.

Cost of Deferred Principal: the expected cost of financing deferred principal (if any) is calculated in a similar way to the expected cost of financing deferred amounts for the payment deferral:

(20) Expected Cost of Financing Deferred Principal = Deferred Principal Amount x GSE Annual Borrowing Cost x Duration of Modified Loan x (1 – Probability of Flex Mod Redefault)

[37] Source: Basics of Fannie Mae Single-Family Reperforming Loan (RPL) Securitization.

Any forborne principal, which is non-interest bearing, must be financed by the GSE from the RPL sale date to the expected payoff date of the modified loan. Note that the financing of the forborne principal from the modification effective date to the RPL sale date has already been captured in the interest paid on the funds borrowed to purchase the loan out of the MBS pool.

The Duration of the Modified Loan is calculated using the equations in Section A2. The average expected cost of financing deferred principal is about $2,070, or 0.8% of UPB at default. Whereas 72% of SDQ loans will require principal forbearance to reach the 20% P&I reduction target for the Flex Mod, the average amount (about $21,700 or 8.4% of UPB at default) is relatively modest compared to the 30% UPB limit in the Flex Mod rules.

Cost of Redefaults: the fourth component in Equation (4) accounts for Flex Mods that redefault. Since we assume all Flex Mod redefaults occur before the RPL is sold and no additional home retention alternatives are provided, we only include the expected Flex Mod costs for those loans that do not redefault in Equations (5), (18), and (20). The fourth term of Equation (4) applies the expected cost of disposition from Equation (1) to those Flex Mod loans that redefault. Equation (1) includes the probability of disposition given default, which accounts for Flex Mod redefaults that self-cure. Flex Mods that fail and end in disposition have the same loss severity as other GSE loans that end in disposition.

The expected cost of disposition is calculated using Equation (1) after substituting UPB at redefault for UPB at default. UPB at redefault is the capitalized UPB of the Flex Mod before any principal is deferred. Our weighted-average UPB at redefault is $272,400. Since 60% of Flex Mod redefaults go to disposition and loss severity is 28%, the expected cost of disposition is about $45,800. We assume 45% of Flex Mod recipients redefault, so Flex Mod redefaults cost the GSEs $20,610.

Total Cost of the Flex Mod: adding the components of Equation (4) together, which includes the $1,000 incentive payment paid to mortgage servicers for each Flex Mod once the three-month trial payment plan is completed, the expected cost of the average Flex Mod works out to $37,391, or 14.5% of UPB at default. Relative to the disposition scenario, each Flex Mod provided saves the GSEs $6,000 or 2.3% of UPB at default.

As noted above, most of the cost of providing the Flex Mod is due to the loans in the GSE portfolio with a well-below-market note rate. As shown in Table A1, the 30-year loans from the 2020 and 2021 vintages make up 36% of the SDQ portfolio and have an average note rate of around 3.30%. These two loans have an RPL sales price of about 83.3% and disproportionately contribute to the average cost of the Flex Mod.

However, over time, we expect the savings from the Flex Mod to increase as the note rate on SDQ loans in the GSEs' portfolios catch up to market rates. In a scenario where mortgage rates remain high (e.g., above 6%), the proportion of loans with a below-market note rate in the GSE portfolio will slowly fall as these borrowers sell their houses and move, and the

turnover will naturally reduce the cost of the Flex Mod. In the opposite scenario, in which the mortgage rate drops to the 3% range, RPL sales prices will increase to par or even above par, in which case the cost of the Flex Mod will also decrease. Because the Flex Mod only reduces the modified interest rate enough to reach the 20% payment reduction target, to the extent that the modified interest rate is above the prevailing mortgage rate, the GSEs will be able to sell reperforming loans above par.

For example, if the RPL sales price across the portfolio were par instead of the 90.07% average, the average cost of the Flex Mod would drop to about $23,900, driven almost entirely (82%) by Flex Mod redefaults that end in disposition. In this case, the savings generated by the Flex Mod would increase to $19,400. In Section A4 we illustrate how changing our model inputs impacts our results, including at higher and lower mortgage rates.

It is important to note that the Flex Mod is highly effective at reaching the 20% P&I reduction target and, since subsequent reperformance is driven by payment reduction, is an effective home retention tool. The average P&I reduction delivered across the portfolio is 19.4%, and 86% of the loans in the SDQ portfolio reach the 20% P&I reduction target. For the 14% of loans that fall short of the target, the P&I reduction is still substantial: the average P&I reduction for this subset is 14.1%. Most of this subset is composed of 30-year loans originated in 2018 and 2019, which are projected to have an average MTMLTV of just under 50%, rendering them ineligible for an interest rate reduction or principal forbearance.[38] With term extension as the only available lever for these loans, the Flex Mod still generates a substantial P&I reduction of 14.1%.

Computing the Expected Cost of a Market-Rate Modification

To complete a Market-Rate Modification, we assume the servicer modifies the terms of the loan and, once the borrower completes a three-month trial payment plan, purchases the old SDQ loan out of the MBS pool and securitizes the modified loan. We assume the market-rate modification targets a 20% P&I reduction and attempts to reach the target by capitalizing arrearages, extending the term to 30 years, and setting the note rate to the prevailing mortgage rate (i.e., PMMS) + 0.25%.

Just as we did for payment deferral and Flex Mod, we must account for market-rate modification recipients who redefault, some of whom will lose their home to disposition. The market-rate modification changes the P&I of our 20 representative SDQ GSE loans by different amounts depending on the original note rate and term. For example, our 15-year loan originated in 2015 receives a 52% payment reduction, whereas the 30-year loan originated in 2021 receives a 49% payment *increase*, and these two modifications will have starkly different expected redefault rates. As noted above, in general, market-rate

[38] With the modification interest rate at 7.00%, even if the MTMLTV for this subset of loans were above 50%, their 4.41% average note rate would not allow for interest rate reduction either.

modifications are not effective at delivering payment reduction today because the current mortgage rate is well-above the note rate on the outstanding stock of GSE loans; the weighted-average P&I change provided by a market-rate modification for our representative portfolio is an increase of 26%.

In addition, all other factors held equal, we expect that borrowers who indicate that they can resume their original monthly payment would have lower redefault rates compared to borrowers who do not and require payment reduction to make their mortgage affordable. Therefore, we need two functions to translate changes in P&I to expected redefault rates, one for each set of borrowers.

First, to map payment changes from market-rate modifications to redefault probabilities for borrowers who state that they can resume their original payment, we use the "payment resumption" redefault function described in Section A3. To the extent the modified payment resulting from a market-rate modification matches the original payment, the payment resumption redefault function returns a redefault rate of 33.6%, which is consistent with our assumed 30% redefault rate for payment deferral.

It is important to note that our estimated savings from the GSE home retention programs are not particularly sensitive to our payment resumption redefault function. As discussed in Section A4, we would have to limit the payment resumption redefault rate to a maximum of 31% regardless of the size of payment increases to eliminate the savings created by the existing GSE home retention programs. Such a limit would imply that, for these borrowers, the expected redefault rate would remain 31% even if a market-rate modification doubled their monthly payment, which is unlikely to be the case.

Second, to map payment changes to redefault probabilities for borrowers who are provided payment reductions, we use a "payment reduction" function derived from a study that tracks post-modification redefault rates for borrowers who received varying amounts of payment reduction either from a HAMP modification or a private modification, as described in Section A3.[39] The output from the payment reduction function aligns with our assumption that 45% of Flex Mods redefault: our function indicates that borrowers who receive a 20% P&I reduction target redefault at a 47% rate. For the market-rate modification, the average 26% P&I increase results in an 81% redefault rate for borrowers who are provided with payment reductions. It is important to acknowledge that while market-rate modifications are ineffective at providing payment reductions in conditions like those of today, where the mortgage note rates are lower than the prevailing market rate, they *can* provide payment reductions when the prevailing mortgage rate is at or below the

[39] Our function is derived from the data presented in Figure 30 from ganong_noel_liquidity_vs_wealth_2020_appendix.pdf. The authors' function parameters are available from GitHub - ganong-noel/mtg_mods_public: Repkit for Liquidity vs. Wealth in Household Debt Obligations: Evidence from Housing Policy in the Great Recession.

existing note rate on the outstanding stock of SDQ loans, and we discuss this scenario in Section A4.

To complete a market-rate modification, the servicer purchases the delinquent loan out of the pool at par. However, unlike the Flex Mod, the note rate on the modified loan is always set to PMMS + 0.25%, thus the "market-rate modification" designation. So, when the servicer sells the modified loan for securitization, the sale is also made at par (or slightly above par, in which case the servicer retains the premium over par). Since the RPL sales price is always at or above par, if we ignore the cost of expected redefaults, the market-rate modification is much less costly (in the current market conditions discussed above) than the Flex Mod.

In calculating the cost of the market-rate modification for each representative loan, we use the same 6.76% PMMS rate and assumption that each borrower has missed nine payments (P&I plus T&I).

We compute the expected cost of a market-rate modification to the GSEs as:

(21) *Expected Cost of Market-Rate Modification = Expected Cost of Interest Paid on Servicer Advances + (Probability of Market-Rate Modification Redefault x Expected Cost of Disposition) + Incentive Payment*

where

(22) *Expected Cost of Interest Paid on Servicer Advances = (((Number of Missed Payments + Months to Complete Modification)/2) x (P&I + T&I) x (GSE Annual Borrowing Cost /12))*

As we did for the Flex Mod, we assume P&I and T&I are advanced each month and that the GSEs reimburse servicers for those advances each month. This assumption may lead to a slight overstatement of the cost of the market-rate modification, but these costs are small and not material to our results—the average expected cost of interest paid on servicer advances for the market-rate modification is $42. We further assume that the GSEs pay the mortgage servicer an incentive fee of $1,000 for each market-rate modification completed.

Each representative loan gets a different amount of P&I reduction so redefault probabilities for borrowers who state that they can resume their original monthly payment range from 18% to 94% and average 70%. For borrowers who do not and are offered payment reduction, redefault probabilities range from 20% to 93%, and the average redefault probability is 81%. Recall that the average change in P&I provided by a market-rate modification is an **increase** of 26%, so the high average redefault rates are to be expected.

For market-rate modifications that redefault, we apply the expected cost of disposition from Equation (1) after substituting UPB at redefault for UPB at default. UPB at redefault is the same capitalized UPB we use for Flex Mod redefaults ($272,400). To account for self-

cures, Equation (1) includes the probability of disposition given default. Market-rate modifications that fail and end in disposition have the same loss severity as other GSE loans that end in disposition.

Using Equation (1), the expected cost of disposition is then $45,800. We then apply the redefault probability for each representative loan for borrowers who indicate they can resume their original payment and arrive at an average expected cost of market-rate modifications that redefault of $32,700 or 12.7% of UPB at default. Similarly, we apply the redefault probability for each representative loan for borrowers who receive payment reduction and calculate an expected cost of market-rate modifications that redefault of $37,900, or 14.7% of UPB at default.

Adding the components of Equation (21) together, including the $1,000 incentive payment, results in a market-rate modification average cost of $33,700 (12.8% of UPB at default) for borrowers who state that they can resume their original payment and $38,900 (14.9% of UPB at default) for borrowers who requirement payment reduction.

A market-rate modification could also have a 40-year term and a note rate of PMMS + 0.50%.[40] Because 40-year loans can be harder to securitize, as compensation 40-year modifications typically have a 0.25% higher note rate than 30-year modifications. The economics of a 40-year market-rate modification at PMMS + 0.50% are similar to the 30-year, PMMS + 0.25% version: the average modification costs $31,300 for borrowers who say they can resume their original payment and $37,800 for borrowers who need payment reduction, and so the comparisons with the current GSE home retention alternatives do not change materially if the market-rate modification term is 40-years and the rate is PMMS + 0.50%.

Comparing the Cost and Performance of a Flex Mod and a Market-Rate Modification

For any credit risk holder to generate real cost savings from home retention, it is critical to have at least one alternative that produces sufficient payment reduction to generate loan reperformance in a cost-effective manner in all interest rate environments. In the current interest rate environment, the Flex Mod is more cost-effective than a market-rate modification. Because the Flex Mod can generate payment reductions for loans with below-market note rates, relative to a market-rate modification the Flex Mod generates better loan reperformance (by 36 percentage points averaged over our representative portfolio) which leads to a lower expected disposition rate for SDQ loans (by 22 percentage points) and therefore a lower expected cost to the GSEs (by about $1,540).

It is noteworthy that as time passes and the GSE portfolios turn over, the cost advantage of the Flex Mod over a market-rate modification will increase. As discussed above, the cost to

[40] For example, FHA's 40-year modifications using a modification interest rate of PMMS + 0.50%, as per Updates to Servicing, Loss Mitigation, and Claims.

provide a Flex Mod is very much dependent on the difference between the prevailing mortgage rate and the note rate on the outstanding stock of GSE loans, because this difference drives the gains or losses created when Flex Mod RPLs are sold. With portfolio turnover, post-Flex Mod RPL sales prices will increase.

The future cost improvement of the Flex Mod is evident when we compare the costs of a Flex Mod and a market-rate modification for the most recently originated loan in our representative portfolio. As shown in Table A1, the 2024 30-year loan has a 6.98% note rate. The Flex Mod provides a 20% P&I reduction, has an expected cost of $23,000 because the RPL sales price is above par, and an expected post-modification disposition rate of 27%. A market-rate modification results in a P&I increase of 6%, costs $41,500, and has an expected disposition rate of 43%. Thus, for the most recent loan in our representative portfolio, the Flex Mod costs $18,500 less than a market-rate modification and cuts the disposition rate by 41%.

To the extent mortgage rates fall, the total cost of the Flex Mod will improve significantly relative to a market-rate modification. At lower mortgage rates, the Flex Mod will retain much of its advantage in lower redefault and disposition rates relative to the market-rate modification, but the cost of providing the Flex Mod will drop considerably as RPL sales prices rise, increasing the relative cost-effectiveness of the Flex Mod. Moreover, because the Flex Mod only reduces the modified interest rate by just enough to reach the 20% payment reduction target, to the extent that the modified interest rate is above the prevailing mortgage rate, the GSEs will be able to sell reperforming loans above par, further reducing the cost relative to a market-rate modification.

Conversely, should mortgage rates increase from here, before the GSE portfolio has the chance to turn over, replacing older, low-rate loans with new loans at higher rates, the expected cost of the Flex Mod may exceed the expected cost of a market-rate modification on a standalone basis. However, substituting a market-rate modification for the Flex Mod would lead to more dispositions and higher costs for the GSEs at the portfolio level. If a market-rate modification were offered in lieu of the Flex Mod, it would increase the P&I payment for most SDQ loans. As discussed in Section III, the non-response rate would increase because borrowers in need of payment relief would not have a viable home retention alternative. Therefore, substituting a market-rate modification for the Flex Mod could increase dispositions in two ways. First, the market-rate modification itself has a higher expected disposition rate than the Flex Mod because borrowers cannot afford the new payment, as described above. Second, SDQ borrowers may fail to respond to an unappealing offer and transition directly from default to disposition if they cannot self-cure.

For example, if we leave our assumptions unchanged and apply the same non-response rate of 25% to a scenario in which the GSE home retention alternatives include payment deferral and a market-rate modification, for the existing GSE portfolio of SDQ loans, it would increase the expected cost of home retention by $128 million and lead to an

additional 10,000 dispositions. If the SDQ rate were to increase to the COVID-pandemic high of 3.32%, the expected increase in the cost of home retention would be $1.4 billion due to an additional 102,000 dispositions.

Even if the non-response rate did not increase from 8%, substituting a market-rate modification for the Flex Mod would still increases the cost of the GSEs' home retention programs. For the current SDQ GSE portfolio, the cost would increase $56 million due to an additional 8,000 dispositions, and in the pandemic scenario, the cost would increase $596 million due to an additional 82,000 dispositions.

We explore the sensitivity of our results to mortgage rates and other model inputs in Section A4.

Section A2: Loan Prices and Durations for the Flex Mod and Payment Deferral

To calculate the cost of payment deferral and the Flex Mod, we need to estimate the price at which RPLs can be sold and the duration of existing and modified loans to determine the cost of deferring arrearages and principal. To do so, we create simple functions to compute a price and duration for a loan with a given note rate and term.

It is important to acknowledge that the functions for calculating a loan price and duration described below are rough at best—there are many factors beyond note rate and term that determine the price and duration of a mortgage. However, given the relative insensitivity of the savings from the GSEs' home retention alternatives to RPL price and duration, simple functions that relate note rate to price and duration are sufficient for our purposes. As noted in Section A4, if we make the conservative assumption that RPLs can only be sold at a two-point discount to our model price or that durations are two years longer than our model estimate, the relative change in cost of the current GSE home retention alternatives is small. Therefore, any potential lack of accuracy in our pricing and duration functions is unlikely to have a material impact on our results.

In addition, because we assume RPLs are securitized and sold as MBS, we further assume the GSEs' retain the associated credit and collateral risk, which absolves us of the need to include these risks in the loan price.

Calculating RPL Prices for the Flex Mod

We begin by calibrating cubic polynomials to price and weighted-average coupon (WAC) data for 30-year and 15-year Uniform MBS (UMBS), the common security issued by either Fannie Mae or Freddie Mac.[41] The 30-year UMBS price (our output) for each WAC (our input) are shown in Figure A1. The points in Figure A1 are actual UMBS prices and the dashed line

[41] As described in Fannie Mae and Freddie Mac Uniform Mortgage-Backed Securities. UMBS price data is from the JP Morgan MBS Pricing and Analytics Package dated 2/2825.

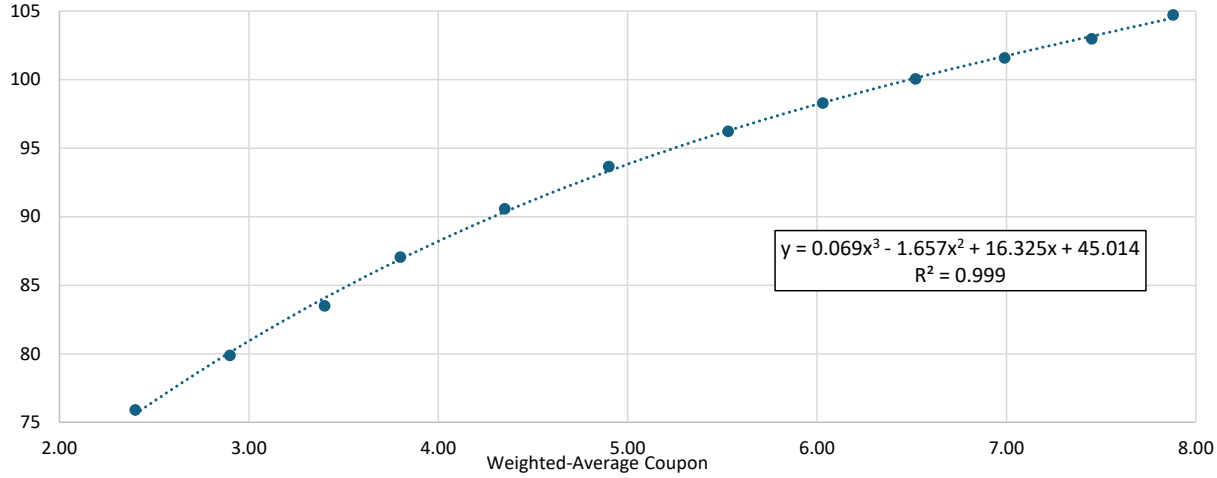
is our pricing function. For a given WAC (expressed in points rather than percent), UMBS prices are computed as:

(23) 15-Year UMBS price = (0.072 x WAC^3) + (-1.267 x WAC^2) + (9.795 x WAC) + 71.867

(24) 30-Year UMBS price = (0.069 x WAC^3) + (-1.657 x WAC^2) + (16.325 x WAC) + 45.014

Given these two pricing functions, we can compute the hypothetical RPL sale price of any of our 15-year and 30-year loans based on their note rate. We price loans with a term longer than 30 years using our pricing function for 30-year loans.

Figure A1. 30-year UMBS Price as a function of WAC.



Source: JP Morgan MBS Pricing and Analytics Package dated 2/28/25 and author's calculations.

However, our pricing functions need to be dynamic, because we want to compute the cost of the Flex Mod for a static set of loans with fixed note rates *as the prevailing mortgage rate varies*. Therefore, we need a function that can compute the hypothetical price of a loan based on the difference between its note rate and our mortgage rate input. To do so, we calibrate additional pricing functions that take as inputs the loan term and the "rate spread", or difference between the note rate and the current mortgage rate used in our model.

As a first step, we use Equations (23) and (24) to solve for the "current origination coupon," or the WAC for which the UMBS price equals 101. Most lenders will originate loans at a 101% price (or higher) so that they can keep the premium over par or 100% as a profit. Our 30-year current origination coupon is 6.776% and our 15-year current origination coupon is 6.197%. Note that the 30-year current origination coupon is consistent with the 30-year PMMS rate used in our model (6.76%) and the spread between our 30-year and 15-year

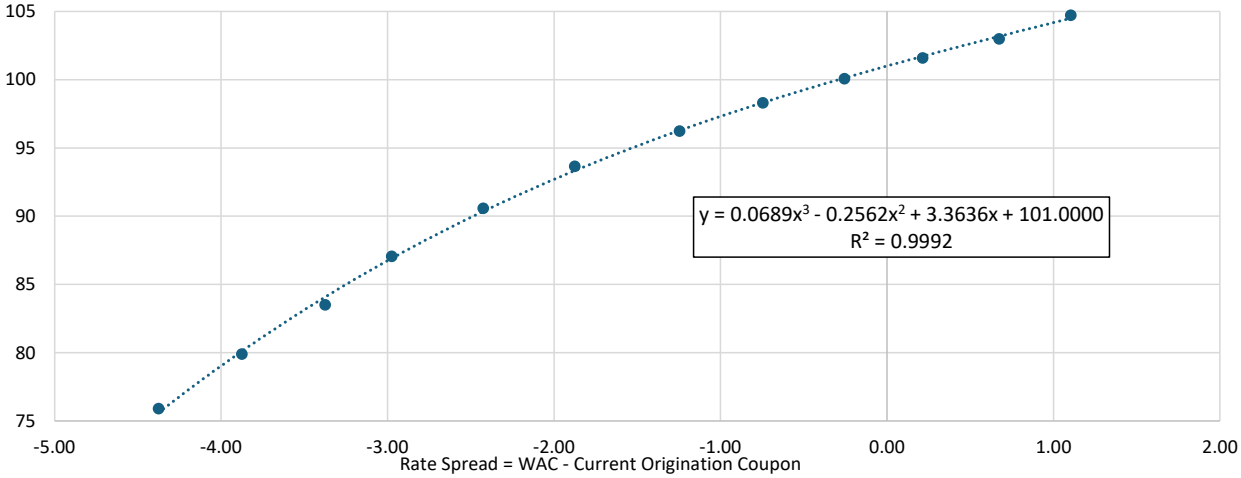
current coupons (0.58%) is similar to the long-term 30-year minus 15-year rate spread used in our model (0.73%).

We then compute the rate spread for each WAC as:

(25) 15-Year Rate Spread = WAC – 15-Year Current Origination Coupon
(26) 30-Year Rate Spread = WAC – 30-Year Current Origination Coupon

We then return to our UMBS pricing data and calibrate a second set of cubic polynomials to the rate spread and UMBS price. The 30-year UMBS price for each rate spread is shown in Figure A2. Again, the points in Figure A2 are actual UMBS prices and the dashed line is our pricing function.

Figure A2. 30-year UMBS price as a function of rate spread.



Source: JP Morgan MBS Pricing and Analytics Package dated 2/28/25 and author's calculations.

Now, for a loan with a given rate spread, the price can be calculated as:

(27) 15-Year Loan Price = (0.072 x Rate Spread^3) + (0.069 x Rate Spread^2) + (2.368 x Rate Spread) + 101.000
(28) 30-Year Loan Price = (0.069 x Rate Spread ^3) + (-0.256 x Rate Spread^2) + (3.364 x Rate Spread) + 101.000

Consistent with the GSEs' policies on securitization, loans with a term of 15 years or less are priced using the 15-year UMBS price formula, whereas loans with a term greater than 15 years, including 40-year terms, are priced using the 30-year UMBS price formula. To compute the rate spread for each loan, we use Equations (25) and (26) and substitute the note rate for WAC. For loans with a term of 15 years or shorter, we substitute the (30-year PMMS Rate minus the 30y – 15y Rate Spread) for the 15-Year Current Origination Coupon. For loans with a term greater than 15 years, we substitute the 30-year PMMS Rate for the 30-Year Current Origination Coupon.

To simulate movements in the mortgage rate, we substitute our new mortgage rate for the current origination coupons in Equations (25) and (26). To illustrate how we use the pricing function, let's use the 2021 vintage 30-year loan in our representative portfolio, which has a 3.26% note rate. At the current mortgage rate, we can use Equation (24) to estimate a price of 83.01. However, if we want to estimate the price of this loan at a 5% mortgage rate, we need Equation (28), and if we input the rate spread calculated using Equation (26) as 3.26 - 5 = -1.74 into Equation (28) it returns a price of 94.01. Similarly, to estimate the price of this loan at an 8% mortgage rate, inputting 3.26 – 8 = -4.74 into Equation (28) returns 71.96. As one would expect, if the mortgage rate drops to 5%, a loan with a 3.26% note rate would increase in price (from 83.01 to 94.01), whereas if the mortgage rate increases to 8%, it would decrease in price (to 71.96).

It is important to note that using Equation (28) with the mortgage rate set to the origination current coupon rate results in the same output as Equation (24)—in other words, inputting 3.26 - 6.776 = -3.516 into Equation (28) also returns 83.01, matching the output of Equation (24) with an input of 3.26.

We use Equations (27) and (28) to estimate the price at which the GSEs will be able to sell RPLs, with a minimum RPL price of 10. While the GSEs can sell RPLs via securitization into MBS (and retain the credit and collateral risk) or through a negotiated sale directly to investors (where investors take the credit and collateral risk), we assume all RPLs are either sold through securitization or marked-to-market at prices that reflect securitization.[42] While we can (roughly) model prices for RPL sales in MBS format because UMBS pricing is readily available, modeling prices for structured products that include credit and collateral risk is well beyond the scope of this paper. Therefore, we assume that sales to investors are priced efficiently for the differences in risk, such that the GSEs are economically indifferent between RPL sales through securitization and RPL sales to private investors.

Calculating Loan Durations

In addition to estimating an RPL sale price, we also need to estimate loan duration, which is required to compute the cost of payment deferrals (Equation (3)) and the cost of deferring principal as part of the Flex Mod (Equation (20)).

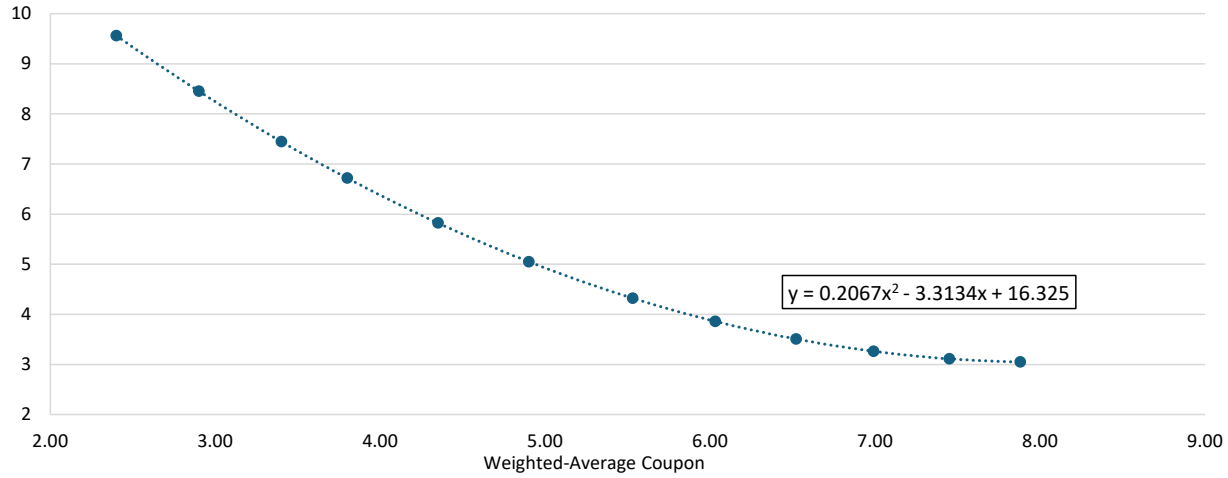
We start by taking the derivative of each cubic polynomial UMBS price function (Equations (23) and (24)), which gives us a quadratic formula for duration for 15-year and 30-year loans of a given WAC:

(29) 15-Year Duration = (0.216 x WAC^2) + (-2.535 x WAC) + 9.795
(30) 30-Year Duration = (0.207 x WAC^2) + (-3.313 x WAC^2) + 16.325

[42] For example, Freddie Mac sells RPLs in MBS format, where they retain the credit risk (Re-Performing Loan MBS Offerings - Capital Markets), and also sells RPLs as part of structured products (Re-Performing Loan (RPL) Senior/Subordinate Offerings - Capital Markets), some of which are non-guaranteed subordinate securities.

We use these duration formulae to compute a duration for each UMBS WAC, as shown in Figure A3 for 30-year UMBS. For example, from Equation (30) or Figure A3, 30-year UMBS with a 3.00% WAC has a duration of about 8.2 years whereas 30-year UMBS with a 7% WAC has a duration of about 3.3 years.

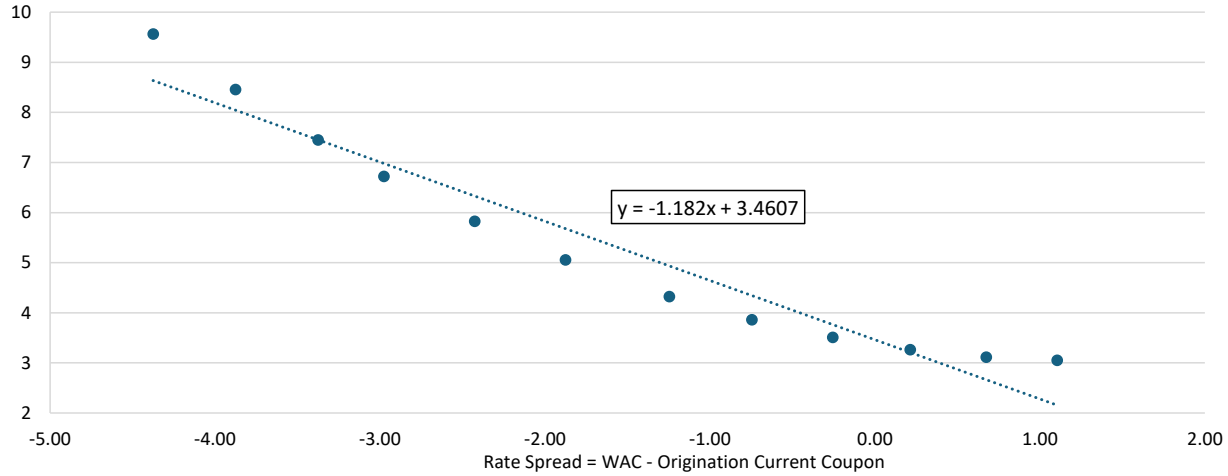
Figure A3. UMBS 30-year duration as a function of WAC.



Source: JP Morgan MBS Pricing and Analytics Package dated 2/28/25 and author's calculations.

We then convert WAC into a rate spread using the current origination coupon, as described above, which gives us a duration for each rate spread (the dots in Figure A4).

Figure A4. UMBS 30-year duration as a function of rate spread.



Source: JP Morgan MBS Pricing and Analytics Package dated 2/28/25 and author's calculations.

However, rather than calibrating a quadratic polynomial to the duration vs. rate spread data, we instead use a linear function (the dashed line and Equation shown in Figure A4) because the linear function ensures that duration is a decreasing function of rate spread:

(31) 15-Year Duration = (-0.595 x Rate Spread) + 2.250
(32) 30-Year Duration = (-1.182 x Rate Spread) + 3.461

To calculate the cost of payment deferral and deferred principal as part of the Flex Mod, we calculate the rate spread for each loan as described in the pricing section and plug the rate spread into Equation (31) or (32), depending on the remaining loan term. Duration is then capped at the remaining term of the loan and floored at six months. For the payment deferral, the remaining term of the loan is calculated as:

(33) Payment Deferral Remaining Term = Original Term – Months from Origination to Default – Number of Missed Payments

To illustrate how we use the duration function, let's use the same 2021 vintage 30-year loan with a 3.26% note rate. At the current mortgage rate of 6.776%, Equation (32) gives us a duration of -1.182 x (3.26 – 6.776) + 3.461 = 7.62 years. If the mortgage rate falls to 3%, the duration would fall to -1.182 x (3.26 – 3.00) + 3.461 = 3.15 years, whereas if the mortgage rate increases to 8%, the duration would increase to -1.182 x (3.26 – 8.00) + 3.461 = 9.06 years. As one would expect, if the mortgage rate falls to 3%, the loan shortens in duration (from 7.62 to 3.15 years), whereas if the mortgage rate increases to 8%, it extends in duration (to 9.06 years).

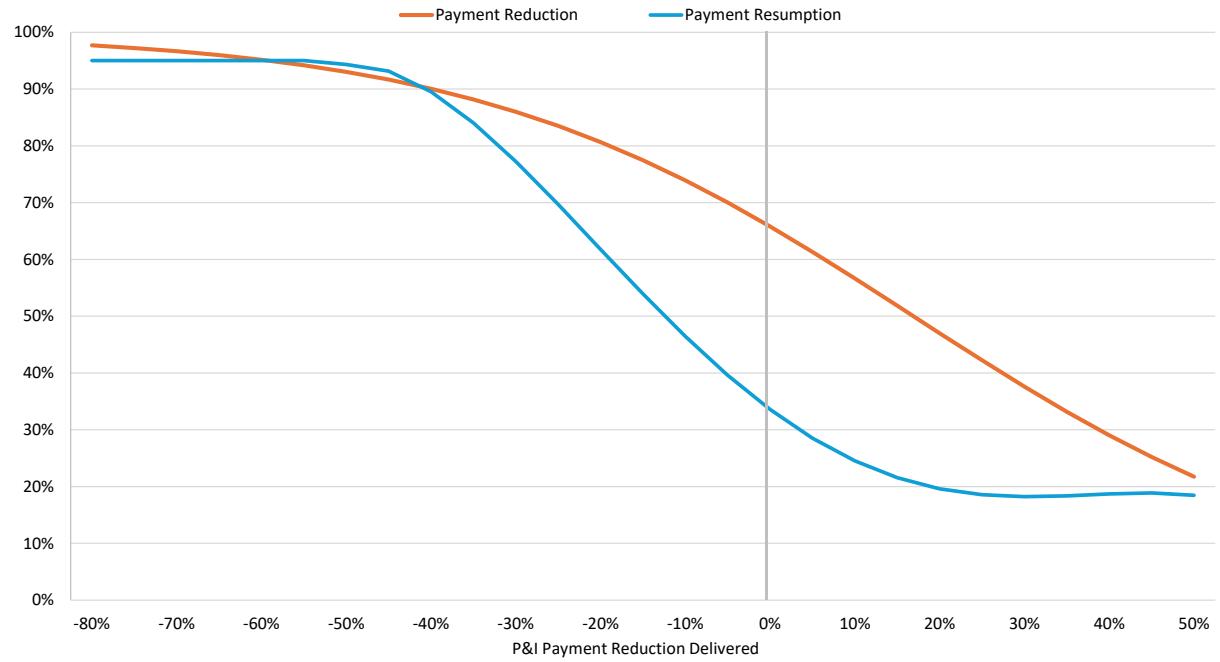
Section A3: Estimating the Probability of Redefault for Various Changes in Monthly Payment

A market-rate modification can increase or decrease the borrower's monthly P&I payment depending on the remaining loan term and the difference between the existing note rate and the prevailing mortgage rate. For example, in the base case, the market-rate modification results in a P&I reduction of 52% for our 15-year 3.74% loan originated in 2015, but a 49% P&I increase for our 30-year 3.26% loan originated in 2021. Post-modification loan performance depends on P&I reduction delivered and, for our purposes, on the borrower's stated ability to resume making their original monthly payment or need for payment reduction. Therefore to estimate the cost of a market-rate modification and the post-modification disposition rate we require two functions that translate P&I changes to post-modification redefault rates.

To create the function for borrowers who require payment reduction, we rely on a study that compares the performance of HAMP modifications to private modifications based on the

different amounts of P&I reduction delivered.[43] This "payment reduction" redefault function is shown in Figure A5. For example, Figure A5 indicates that providing a modification to an SDQ borrower that increases their P&I by 50% would result in a 93% redefault probability, whereas a P&I reduction of 20% would result in a 47% redefault probability.

Figure A5. Probability of Redefault as a Function of Payment Reduction Delivered for Payment Resumption and Payment Reduction.



Sources: ganong_noel_liquidity_vs_wealth_2020_appendix.pdf, GitHub - ganong-noel/mtg_mods_public: Repkit for Liquidity vs. Wealth in Household Debt Obligations: Evidence from Housing Policy in the Great Recession, and author's calculations.

Note that our payment reduction function is likely to assign redefault rates that are too low for P&I reductions beyond 30%, and therefore we underestimate both redefault rates for market-rate modifications and therefore the savings from the current GSE home retention programs. Analysis of GSE post-modification two-year cumulative default rates suggests no improvement in loan performance is achieved by increasing payment reduction from between 20% and 30% (43.2% redefault rate) to between 40% and 50% (43.7% redefault

[43] Our function is derived from the data presented in Figure 30 from ganong_noel_liquidity_vs_wealth_2020_appendix.pdf. The authors' function parameters are available from GitHub - ganong-noel/mtg_mods_public: Repkit for Liquidity vs. Wealth in Household Debt Obligations: Evidence from Housing Policy in the Great Recession.

rate).[44] In contrast, our function indicates that a 25% P&I reduction would result in a 42% redefault rate and a 45% P&I reduction would result in a 25% redefault rate. In a scenario in which PMMS is much lower than the loan note rate, a market-rate modification can result in a payment reduction greater than 30%, whereas the Flex Mod payment reduction cannot exceed 20%. In this scenario, we underestimate the redefault rate, disposition rate, and cost of market-rate modifications, which makes our results conservative.

Our "payment resumption" redefault function, which is used for borrowers who say that they can resume their original monthly payment, is also shown in Figure A5. Finding analysis on which to base the payment resumption redefault function is difficult because SDQ borrowers are not classified according to whether or not they state that they can afford their original payment until they are provided with a home retention alternative, at which point their redefault rate will reflect the home retention alternative provided. In other words, there is no data source, much less analysis, that we are aware of that measures the redefaults of only those SDQ borrowers who stated they could afford their original monthly payment but were instead provided modifications that either increased or decreased their payment.

With these limitations in mind, we begin with the expectation that, for a given amount of payment reduction and all other factors held equal, borrowers who indicate that they can resume their original payment would have lower redefault rates compared to borrowers who state that they require payment reduction, unless payment changes for both are very large. Therefore, our payment resumption redefault rates are lower than our payment reduction redefault rates, except at extreme levels of payment change.

We then calibrate our payment resumption redefault function to three data points. First, market-rate modifications that don't change the monthly payment should have similar redefault rates to our payment deferral redefault rate of 30%, and our function returns 33.6%. Second, for payment increases of 40% or more, the payment resumption redefault rate should be similar to the payment reduction redefault rate, as payment increases of this magnitude are very likely to result in redefaults for both sets of borrowers, since neither of them stated they could afford much higher payments. Third, the marginal impact of payment reductions beyond 30% for both groups should be small, for the reasons cited above.

We test our redefault probabilities for payment *increases* using a study of HAMP modifications that included a step-up in interest rate of 1% five years after the modification took effect. HAMP provided borrowers with a 2% note rate for the first 5 years of their modified loan, after which the note rate increased to 3% in year 6. The authors found that the 1% interest rate increase caused an increase in redefault probability of 20%. The

[44] See figures 6 and 12 in Assessing the effectiveness of payment reduction on preventing borrower re-default for mortgages, which show loan performance results by P&I reduction are similar within credit score bins.

increase in interest rate from 2% to 3% in year six equates to a P&I increase of about 12%, and so we can translate the results from this study into P&I terms—a 12% increase in P&I increased subsequent redefault probability by 20%.

Using the data point provided by the HAMP analysis as a benchmark for market-rate modifications, our payment reduction redefault rate function returns a redefault rate below the benchmark while our payment resumption redefault function returns a redefault rate above the benchmark. Our payment reduction redefault function translates a 12% increase in P&I into a 15% increase in redefault rates, suggesting that we may be underestimating the redefault probability and expected cost of market-rate modifications for borrowers who require payment reduction, which suggests the actual savings from the GSE home retention programs may be higher. In contrast, our payment resumption redefault function translates a 12% P&I increase into a 47% increase in redefault rate, in part because the baseline redefault rate of 34% is a low starting point. As a result, we may be overestimating the redefault probability and expected cost of market-rate modifications for borrowers who state that they can resume their original payment but receive an increase in payment, and therefore overestimating the savings from the GSE home retention programs.

Because the savings created by the existing GSE home retention programs persist unless we limit the payment resumption redefault rate to an unrealistically low level of 31% for any amount of payment increase, we believe the net impact on our results of any potential misestimates noted above is small. As discussed in the next section, to eliminate the savings from the GSE home retention programs relative to market-rate modifications, SDQ GSE borrowers who state that they can resume their original monthly payment would have to have a 31% redefault rate regardless of whether they got a market-rate modification that resulted in no payment change *or a market-rate modification that doubled their payment*. It is extremely unlikely that these two groups would have the same redefault rate. Given how unrealistically low and insensitive to payment increases our payment resumption redefault rates would have to be to eliminate the savings from the current GSE home retention programs, we conclude that it is unlikely that correcting any overstatement of payment resumption redefault rates, after also correcting for our underestimation of payment reduction redefault rates, would have a material impact on our results.

Section A4: Sensitivity Analysis

The savings produced by the current GSE home retention alternatives remain even if we adjust most of our model inputs to extremely conservative levels. The payment deferral and Flex Mod only lose their cost advantage versus disposition and market-rate modifications if loss severity falls to unrealistically low levels (11%) or if the mortgage rate rises above 9.55% before turnover takes the below-market note rates on the loans in the GSE portfolio higher.

Loss Severity: holding other model parameters constant, loss severity would have to drop to 8% in order for the savings generated by the GSEs' home retention alternatives relative to disposition to erode entirely. Loss severity would have to drop to 11% in order for market-rate modifications to have a lower expected cost than the current GSE home retention alternatives. To be clear, the expected disposition rates for SDQ loans under each regime would not change—no home retention alternatives at 60%, a market-rate modification at 48%, and the current GSE home retention program at 22%—but the GSEs' losses associated with each disposition would be smaller.

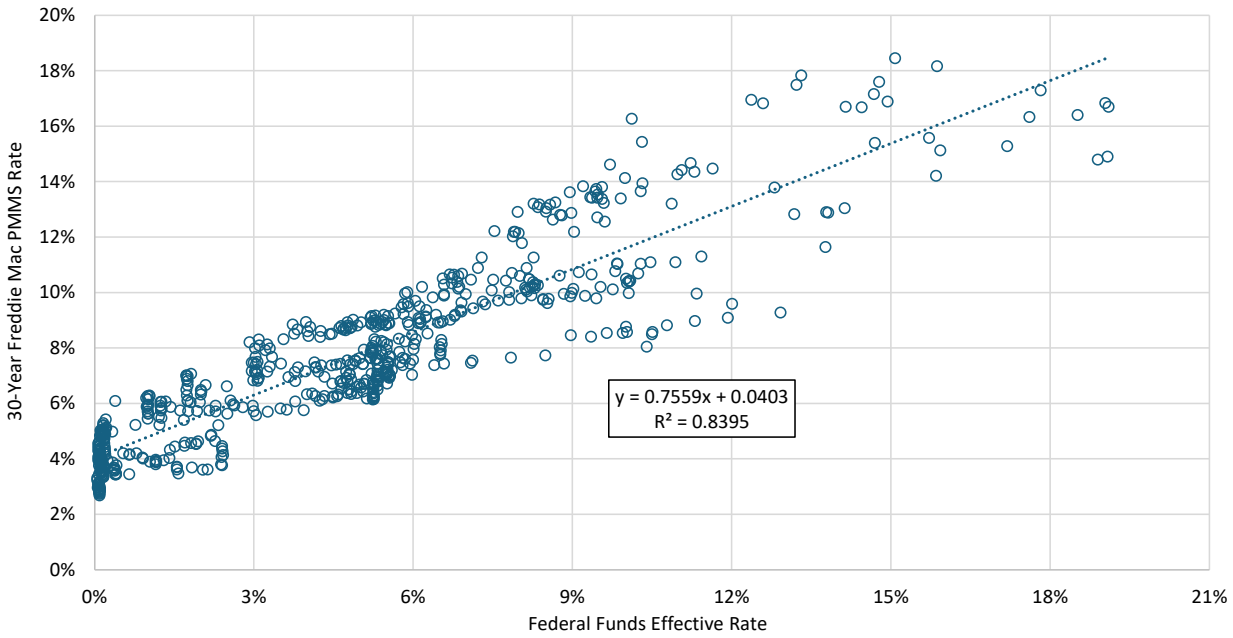
Based on Fannie Mae data, it is unlikely that loss severity would **average** 11% through economic cycles. As shown above in Figure 2, the lowest loss severity experienced in the post-Great Recession period was 14% in 2021, which is based on a small sample size of dispositions due to the foreclosure moratorium and was reduced by the 31% HPA experienced during 2020 – 2021.[45] Aside from 2021, since 2008 Fannie Mae loss severity has ranged from 20% (2023) to 50% (2016). As noted in Section III, HPA alone does not reduce loss severity beyond a certain level.

Mortgage Rates: our model results are most sensitive to the mortgage rate input because the cost of the Flex Mod is driven mainly by RPL sale price and RPL sale price is mainly a function of the difference between the existing, pre-modification note rate and the prevailing mortgage rate. There are three observations to consider regarding the impact of the mortgage rate on the relative cost of the GSEs' home retention alternatives.

First, our choice to use a PMMS rate of 6.76% is in fact slightly conservative because it is somewhat above our estimate of a 6.30% through-the-economic-cycle mortgage rate. We arrive at this estimate by examining the long-term relationship between the Federal Reserve's Federal Funds rate and the PMMS rate, as shown in Figure A6.

Figure A6. Freddie Mac 30-Year PMMS Rate vs. Federal Funds Effective Rate, April 1971 – January 2025.

[45] See Statistical Summary Tables. HPA measured using FHFA's Quarterly Purchase-only, SA HPI available at House Price Index Datasets | FHFA.



Source: 30-Year Fixed Rate Mortgage Average in the United States (MORTGAGE30US) | FRED | St. Louis Fed, Federal Funds Effective Rate (FEDFUNDS) | FRED | St. Louis Fed, and author's calculations.

As seen in the trend line equation in Figure A6, over the last 54 years, the Federal Funds Effective Rate explains about 84% of the variation in the PMMS rate. To develop our estimate of the longer run mortgage rate, we use as the steady state Federal Funds Effective rate the longer run projection of the median federal funds rate of 3.00% provided by the Federal Reserve Board members and Federal Reserve Bank presidents in their March 2025 Summary of Economic Projections (SEP).[46] Based on the trendline equation shown in Figure A6, the longer run PMMS Rate = 0.7559 x 3.00% + 4.03% = 6.30%.

If we use the 6.30% longer run PMMS rate implied by the median longer run Federal Funds rate in the SEP in our model, the savings created by the GSEs' home retention alternatives relative to disposition increase to $20,800 or 7.8% of UPB at default. To arrive at this figure, we assume that the current 2.41% spread between the GSE borrowing rate and the PMMS rate remains in place, which means the GSEs' borrowing cost drops to 3.89%, and that the GSE modification interest rate is also 6.30%. To be clear, the linear relationship depicted in Figure A6 is not perfect—for a given Fed Funds rate there has been considerable variation in the 30-year mortgage rate, which is why we use the current mortgage rate as the baseline for our model.

Second, holding other inputs fixed, including the below-market note rates of the existing GSEs' SDQ portfolio, if the mortgage rate immediately increases above 9.55%, the GSEs'

[46] Source: The Fed - March 19, 2025: FOMC Projections materials, accessible version.

home retention alternatives become more costly than a loss mitigation program without home retention alternatives and more costly than market-rate modifications.[47] However, in this scenario, the market-rate modification would provide an average P&I increase of 63%, resulting in a post-modification redefault rate of 90% and an expected disposition rate of 56%. In contrast, the expected disposition rate under the current home retention programs would remain at 22%. Should the SDQ rate increase in this scenario, the deadweight losses to society averted by the current GSE programs would be significant. Estimates from 2010 indicate the average foreclosure causes a societal dead-weight loss (a loss that is not offset by a gain to another party) of nearly $71,000, 37% of which is borne by the mortgage guarantor.[48] Inflation has driven up the dead-weight loss meaningfully in the fifteen years since.

Moreover, should mortgage rates rise, housing affordability, which is already challenging today, will become even more difficult. A $300,000 loan at the current PMMS rate of 6.76% has a $1,948 monthly P&I payment. At a 9.55% note rate, the monthly P&I balloons to $2,534, an increase of $586/month or 30%. Given the additional affordability challenges presented by a 9.55% mortgage rate, house prices are likely to decline, resulting in an increase in loss severity. This increase in loss severity will make dispositions more costly and therefore increase the benefit of offering home retention alternatives. In addition, the GSEs will retain some of the savings generated by their home retention alternatives if the move to higher mortgage rates happens over time, as over the period more of the existing GSE portfolio will turn over, reducing the cost of the Flex Mod.

Third, in the opposite scenario, if mortgage rates fall to low levels, the savings from home retention relative to disposition increase. For example, at a 3.00% PMMS rate, the savings created by the current home retention alternatives relative to disposition increase to $29,200 per completed action, or 11.3% of UPB at default.[49]

Relative to a market-rate modification, the savings fall to $2,600 per completed action (1% of UPB at default). In this scenario, because RPL sales prices are well above par, the expected cost of the Flex Mod drops to $13,900, which is $10,200 less than the cost of a market-rate modification provided to borrowers who need payment reduction. And while a market-rate modification remains more costly than the Flex Mod, the market-rate modification can provide payment relief. With a 3% PMMS rate, a market-rate modification delivers an average P&I reduction of 18%, which results in an expected redefault rate of 50%. As a result, at a 3.00% mortgage rate, market-rate modifications produce a 23%

[47] In both cases, we hold the spread between the 30-year PMMS rate and the GSE borrowing rate at 2.41% and set the GSE modification interest rate equal to the mortgage rate.
[48] Source: S. Rept. 110-251 - THE 2007 JOINT ECONOMIC REPORT | Congress.gov | Library of Congress.
[49] In this case, we set the GSE modification interest rate to 3.00% but assume the spread between the 30-year mortgage rate and the GSEs' borrowing cost compresses to 1.50%, as it did in 2021 when the 30-year mortgage rate was last at 3.00%.

redefault rate and hold a slight cost advantage ($2,500) over payment deferral for borrowers who indicate they can resume making their original monthly payment.

Holding other model inputs constant, the cost advantage of the GSEs' home retention alternatives relative to disposition are compelling, relative to very conservative settings for our remaining model parameters:

GSEs' Borrowing Cost: our results are not very sensitive to the interest rate at which the GSEs can borrow. Increasing the GSEs' borrowing rate from 4.35% to 7%, which would be quite high in the context of a 6.76% PMMS rate and current rates on investment grade debt, reduces the savings provided by the GSEs' home retention alternatives to $15,150 per action taken relative to no retention alternatives and $7,600 per action taken relative to a market-rate modification.[50]

Non-Response Rate: our 8% non-response rate is estimated based on the percentage of borrowers that were unresponsive following the conclusion of their COVID-19 forbearances. As of February 2024, of the 8.8 million loans that entered forbearance, 5.6% had exited forbearance, were delinquent, and were not in active loss mitigation; 1.2% exited through a distressed liquidation; and 1.1% exited and were in active foreclosure.[51] We use these borrowers (7.9% of forbearance entrants) as an estimate of unresponsive borrowers.

Our portfolio level results are not very sensitive to the percentage of SDQ borrowers who are not in contact with their servicer and therefore do not take a home retention alternative and either self-cure or lose their home to disposition. For example, if we increase the non-response rate for the current GSE home retention programs from 8% to 25% while leaving the non-response rate for market-rate modifications at 25%, the savings created by the current home retention alternatives at the GSE portfolio level are still considerable, as shown in Table A4. In this case, the GSEs' home retention alternatives will avoid about 28,000 dispositions, saving the GSEs $1.4 billion. The savings relative to a traditional market-rate modification remain compelling: the current GSE home retention programs will avoid about 17,000 dispositions, saving the GSEs $0.8 billion.

Should the GSE SDQ rate increase to the pandemic-high of 3.32% and 25% of those borrowers be non-responsive, relative to a scenario with no home retention, the current GSEs' programs would avoid about 296,000 dispositions, saving the GSEs $14.4 billion. Relative to market-rate modifications, the current home retention programs would avoid 177,000 dispositions, saving the GSEs $8.6 billion.

[50] For example, as of February 28, 2025, JP Morgan's JULI investment grade corporate bond index had a spread over US Treasuries of 99 basis points, suggesting a yield of roughly 5.20%.
[51] Source: March-Mortgage-Monitor-report.pdf.

Table A4. Portfolio-Level GSE Savings from Home Retention Alternatives with a 25% Non-Response Rate.

Portfolio-Level Savings from Current Home Retention Programs	Current SDQ Rate	COVID Peak SDQ Rate
GSE-backed Loans (millions)	30.9	30.9
SDQ Rate	0.31%	3.32%
SDQ Loan Count	96,450	1,026,743
Relative to no Home Retention Options		
GSEs' Savings ($ billions)	1.4	14.4
Avoided Foreclosures	27,778	295,702
Relative to Market-Rate Modifications		
GSEs' Savings ($ billions)	0.8	8.6
Avoided Foreclosures	16,651	177,256

Source: Author's calculations.

It is worth noting that it is unlikely that the non-response rates for the current home retention programs and market-rate modifications will be equivalent. Payment deferral offers a simple way for guarantors to bring current delinquent borrowers who have overcome a temporary hardship and in nearly every scenario the Flex Mod will deliver as much or more payment reduction than a market-rate modification, and therefore one would expect a lower non-response rate to the current home retention programs than to market-rate modifications.

It is also important to note that the per-action-taken savings from the GSEs' current home retention alternatives persist even as the non-response rate increases, such that the portfolio-level savings do not fall to zero until the non-response rate reaches 100%.

Payment Deferral vs. Flex Mod Take-up Rates: payment deferral is less costly than the Flex Mod because the former alternative does not require the delinquent loan to be bought out of the MBS pool, and therefore to the extent the take-up rate for payment deferral were lower (and take-up of the Flex Mod higher), it would increase the cost of the home retention alternatives. However, even if the take-up for payment deferrals dropped to 25% and 75% of SDQ loans were resolved using a Flex Mod, the home retention programs would still save the GSEs about $11,300 per retention action completed, or 4.4% of UPB at default. Relative to market-rate modifications, the savings would be $5,500 per action taken (2.1% of UPB at default).

Probability of Disposition Given Default: If the probability of disposition given default for all defaults (defaults not treated with home retention alternatives and redefaults after the application of payment deferral, Flex Mod, or a market-rate modification) fell to 23%, the savings from the GSEs' home retention alternatives relative to disposition would fall to zero. However, it is extremely unlikely that only 23% of SDQ loans would go through to disposition without intervention (or additional intervention in the case of redefault), since this would imply that an unreasonably high 77% of SDQ borrowers self-cured.

For added context, the self-cure rates implied by our baseline assumptions shown in Table 4 under no home retention alternatives (40%) and market modifications (31%) are already at the upper end of the range implied by CARES Act forbearance exits that were possibly self-cures (11% to 42%), which makes the 77% self-cure rate noted above unrealistic.

Between 11% and 42% of exits by borrowers who took CARES Act forbearance and missed at least 1 payment were the result of self-cures. Since not all of these loans were seriously delinquent, we use forbearance exits that may have resulted from a self-cure as an *upper bound* for SDQ self-cure rates, as it is easier for borrowers who miss one or two payments to self-cure compared to borrowers who miss three or more payments.

Industry data as of February 2025 shows that 11% of DQ borrowers exited CARES Act forbearance and reinstated their loan without assistance from a home retention option.[52] These are likely all self-cures. An additional 8% exited forbearance by paying off their loan.[53] While many of these payoffs are market sales, some could be refinances. And 23% of borrowers exited forbearance and were delinquent but not in loss mitigation, and some of these borrowers could have either reinstated their loan without using loss mitigation or completed a market sale later.[54] Therefore, using reinstatement exits as the minimum and the sum of all three exits as the maximum suggests that between 11% and 42% of DQ borrowers who exited forbearance were self-cures.

To the extent that the actual transition rate from default to disposition is higher than our 60% assumption, the savings from the GSE home retention programs will increase.

Redefault Probabilities: if all Flex Mods end in redefault, which is an unreasonably adverse outcome given historical redefault rates for Flex Mods, the GSEs' home retention alternatives still save $14,900 relative to no home retention alternatives because 60% of SDQ loans are resolved with payment deferral. If all payment deferrals end in redefault, which is again an unreasonably adverse outcome, the expected savings per home retention action taken drops to $1,100 relative to disposition. Even if home retention is wholly ineffective and 90% of Flex Mods and 90% of payment deferrals end in redefault, the home retention alternatives would still yield a modest savings ($500) for the GSEs relative to disposition.

We do not examine the relative sensitivity of redefault rates between the Flex Mod and market-rate modifications for borrowers who need payment reduction because at the current mortgage rate and at our long-term mortgage rate (6.30%), the market-rate modification results in an increase in P&I on average for our representative portfolio, and therefore it would be unreasonable to assume a market-rate modification could have a lower redefault rate than payment deferral or a Flex Mod. As noted above, the only scenario

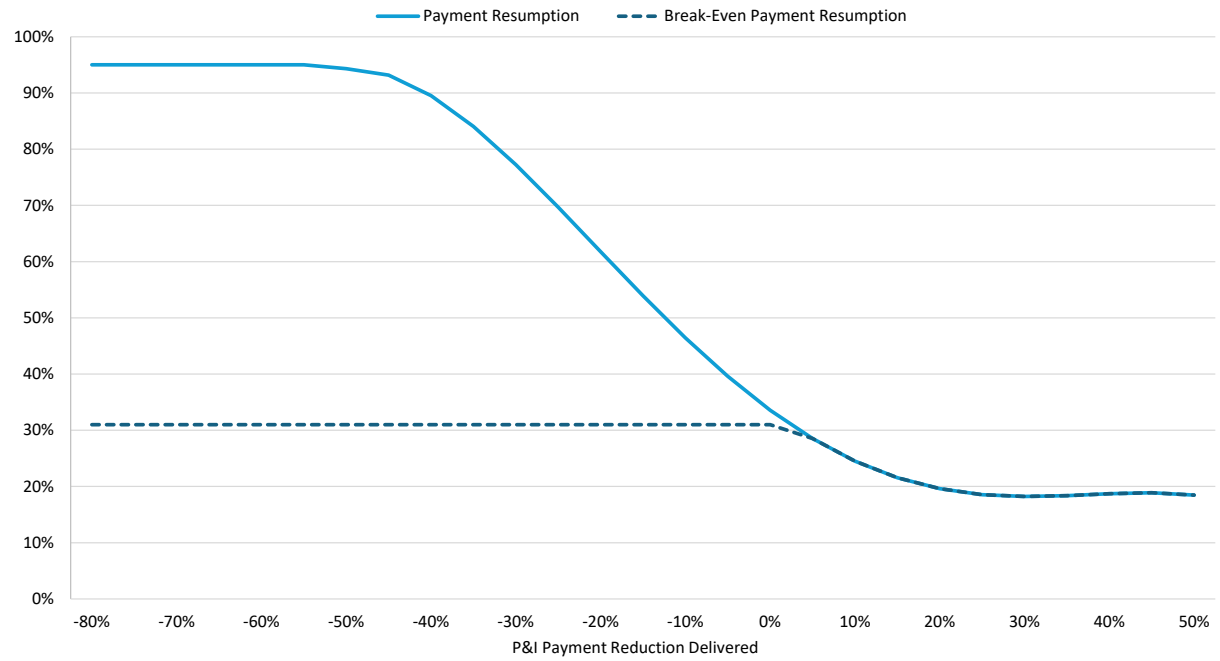
[52] Source: The Mortgage Bankers Association (MBA) Monthly Loan Monitoring Survey, March 2025.
[53] Ibid.
[54] Ibid.

in which the market-rate modification can deliver payment reduction to the existing stock of SDQ GSE loans is if the mortgage rate were to drop significantly. However, in this scenario, the Flex Mod becomes much cheaper than a market-rate modification, as described in the discussion on mortgage rate sensitivity.

We test the sensitivity of our results to our payment resumption redefault function by determining the payment resumption redefault rate at which the existing GSE home retention programs and market-rate modifications would have the same expected cost. In other words, we find the "break-even" payment resumption redefault function by solving for the rate at which, if we limit payment resumption redefaults, the savings from the GSE home retention programs relative to market-rate modifications drop to zero. Our original payment resumption redefault function (solid line) and the break-even payment resumption redefault function (dashed line) are shown in Figure A7.

The savings from the GSE home retention programs relative to market-rate modifications do not fall to zero unless the payment resumption redefault rate is limited to 31% regardless of the size of any payment increases. That is, in order to make the expected costs of the GSE home retention programs and market-rate modifications equivalent, we would have to limit the payment resumption redefault rate to 31%, which means that this set of borrowers would be expected to reperform on their market-rate modification at the same rate regardless of whether their modification in fact raises their payment or the amount of payment increase. An outcome in which market-rate modifications that result in 0% and 80% payment increases have the same 31% redefault rate is extremely unrealistic.

Figure A7. Break-Even Payment Resumption Redefault Rates.



Source: Author's calculations.

Number of Missed Payments: if we increase missed payments to 12 for payment deferral (the maximum permissible over the life of the loan) and 24 for the Flex Mod, the savings from the GSEs' home retention alternatives relative to disposition only decreases slightly, to $15,100. The savings relative to market-rate modifications decrease marginally to $10,800.

Month of GSE loan Buyout: our results are insensitive to when the GSE buys the loan out of the MBS pool to complete a Flex Mod. The GSEs bear the cost of borrowing funds to advance PITI regardless of whether the loan remains in the MBS pool or not, though there may be variations in when servicer advances are reimbursed. Regardless, the cost to the GSEs is similar whether the loan is bought out of the MBS pool after four missed payments or just before it is modified.

RPL sale Price Discount and Timing of RPL Sale: in a high mortgage delinquency environment, one might expect RPL sales to become challenging, and therefore our assumption that RPLs can be sold at equivalent prices to MBS may not hold. However, if we introduce a two-point discount for RPL sales relative to our MBS pricing function, the impact on our result is small—the benefits of the GSEs' home retention alternatives drop to $17,600. Relative to a market-rate modification, the savings from the GSEs' current home retention alternatives declines marginally to $10,000. Our results are similarly insensitive to when the RPL is sold, whether at six months or 18 months after modification, the difference in savings from our base case is insignificant.

Loan Durations: if we underestimate the duration of loans that have a payment deferral or deferred principal as part of a Flex Mod, we will underestimate the cost of the GSEs' home retention alternatives. However, our model results show little sensitivity to duration—even if we increase our model duration by two years for both payment deferral (Equation (3)) and modified loans (Equation (20)), the savings created by the current home retention alternatives relative to dispositions and market-rate modifications decrease by a small amount.