WILARY WINN LLC

Advice to Strengthen Financial Institutions

Mortgage Servicing Rights Valuation – Input Assumption & Shocks

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INTRODUCTION

This white paper is intended to provide insight into the valuation of mortgage servicing rights ("MSR") and the key assumptions used to value them. We also show the relative effect each key assumption has on the overall value by providing sensitivity analyses for each individual assumption.

A mortgage servicing right is the right to service a loan on behalf of an investor and collect a servicing fee. Loan servicing consists of collecting and processing loan payments throughout the life of a loan. Servicing activities also include billing the borrower; collecting principal and interest payments as well as taxes and insurance payments; disbursing property taxes and insurance premiums; accounting for these activities at the loan and investor level; and forwarding funds to an investor in the secondary market. MSRs are a modified interest-only strip. The expected life of the loan is calculated based on its expected prepayment rate and is a key valuation variable.

Input Assumption & Shocks

Major Valuation Components

SERVICING FEE

The servicing fee is paid monthly based on the outstanding principal balance of the loan. Servicing fees vary by type of investor. Standard fees are 25 basis points for fixed rate conventional (Fannie Mae/Freddie Mac) loans, 37.5 for conventional ARM loans, 44 basis points for Ginnie Mae I loans, and between 19 and 56.5 basis points for Ginnie Mae II loans.

ANCILLARY INCOME

Ancillary income includes late fees, insurance income and other fees earned from soliciting the portfolio. It varies by an institution's ability to cross-sell its mortgagors. Wilary Winn's ancillary income assumption is based primarily on forecasted late fees, which are in turn based on the payment amount. The payment amount in turn is based on loan size and the loan's interest rate.

There are a number of firms that survey the marketplace quarterly to obtain information regarding servicing input assumptions. The two most recent surveys we obtained were performed in Q4 2022 and are the surveys that will be referenced throughout this white paper. Wilary Winn benchmarks our ancillary input assumption, as well as other input assumptions to the surveys. We also benchmark our assumptions to the work of other valuation firms obtained through our work as auditor-engaged specialists as described in "AS 1210" of the PCOAB auditing standards. We detail our comparisons by input assumption later in this white paper.

SERVICING COSTS

Servicing costs are best expressed in dollars per loan per year, as they are more closely related to units versus loan size. Valuations based on servicing costs expressed in basis points imply that the cost to service a $300,000 loan is three times that of a $100,000 loan, which is decidedly untrue. The input assumption should consider current and future base costs. Our future costs are based on the long-term forecasted rate of inflation as of the valuation date.

The base servicing cost input assumption is generally based on the marketplace's assumption of the marginal cost to service a loan. The assumption varies slightly by investor. For example, according to the assumption surveys, the median base cost to service a current conforming conventional loan is $64.45 in the first survey and $72.50 in the second survey, while the assumption for a GNMA FHA loan is $75.00 in the first survey and $85.00 in the second survey.

DELINQUENCY RATE AND FORECLOSURE LOSSES

The existing and projected delinquency rate of the portfolio can be an important assumption. A valuation should include the projected incremental costs to service delinquent loans. The valuation should also include foreclosure losses which vary by type of investor. For example, a foreclosure on an FHA-insured loan could result in a loss from costs denied by the FHA as well interest lost from servicing advances. We note that the servicer is required to advance at the note rate while the FHA reimburses the servicer at the FHA debenture rate, which is nearly always lower than the note rate.

Some of the programs offered by the FHLBanks include sales with limited recourse. The servicing valuation should consider the credit risk arising from such sales, as appropriate.

Wilary Winn derives our delinquency assumptions from information provided by the Mortgage Bankers Association, which is released quarterly. We benchmark our cost assumptions to information contained in the MSR assumption surveys and to inputs used by other valuation firms.

FLOAT EARNINGS

Interest income from float arises from two sources. The larger component comes from loans that are escrowed (impounded) for property taxes and hazard insurance. The servicer collects the escrow payment monthly, disburses the insurance annually, and disburses the property taxes quarterly, semi-annually, or annually depending on the jurisdiction. A minor source of float comes from the principal and interest payments. Most payments come in before or near the first-of-the-month due date. Under certain investor programs, the servicer remits these payments later. For example, a servicer remits the actual principal it has received along with the interest it was scheduled to receive to Freddie Mac on the 18th of the month under Freddie Mac's standard remittance methodology. This remittance method is called scheduled/actual. Another common remittance methodology, especially for Fannie Mae loans, is actual/actual where the servicers remit only the funds it has received. Servicers are required to remit scheduled principal and interest to holders of Ginnie Mae MBS.

Some jurisdictions require servicers to pay interest on the mortgagor's escrow account, resulting in less benefit or, in some cases, at a detriment. For example, the state of California requires servicers to pay the mortgagor 2 percent on escrow accounts.

EXPECTED LOAN LIFE - PREPAYMENTS

The expected life of a loan is based on the attributes of the loan, including term and expected prepayments. Wilary Winn models at the loan level and we derive expected cash flows by adjusting the contractual cash flows for:

- Voluntary prepayments – the conditional repayment rate ("CRR")
- Involuntary prepayments – the conditional default rate ("CDR")
- Loss severity or loss given default – the loss that will be incurred on a default which is generally relatively small because the loans are sold without recourse or with limited recourse

The expected loan life is derived from the resulting expected cash flows. The prepayment assumption is the most sensitive input in the model and varies greatly. The secondary market for mortgage loans is enormous and, as a result, there are several prepayment models available in the marketplace. Wilary Winn utilizes the MIAC model which is based on the major mortgage-backed securities ("MBS") dealers' forecasts for prepayments of MBS. We also benchmark the MIAC prepayment model to forecasted prepayments of MBS securities reported by Bloomberg. Prepayments are primarily driven by changes in market interest rates. Other factors affecting prepayments are the original term, the remaining term, the type of mortgage-backed security (FNMA/FHLMC vs. GNMA), and, in some cases, the balance of the loan. (The incentive to refinance a loan with a small balance is less as the interest savings might not be significant relative to the costs of refinancing.) As a result, the MIAC inputs in 2023 are quite granular with 71 tranches for conventional 30-year loans and 32 tranches for conventional 15-year loans. See the attached Appendix A for a sampling of the MIAC prepayment speeds as of April 3, 2023.

Because the MIAC forecast is based on MBS and not the interest rate on the loan, we need to map the loan to the appropriate MBS. The note rate is higher because it includes the servicing fee and the guarantee fee paid to the guarantor – e.g., Freddie Mac, Fannie Mae, Ginnie Mae.

Wilary Winn has reviewed FNMA and FHLMC securitization data from Bloomberg and compared the weighted average coupon ("WAC") to the MBS security rate to calculate the spread between mortgage

interest rates and MBS security rates. For FNMA and FHLMC 30-year and 15-year loans, we calculated the weighted average spreads for 2019 – 2022 MBS securities and the results were as follows.

MBS Spreads - WAC less MBS Coupon				
	30 Year Spreads		15 Year Spreads	
Orig. Year	FNMA	FHLMC	FNMA	FHLMC
2022	0.792%	0.807%	0.639%	0.676%
2021	0.799%	0.817%	0.549%	0.644%
2020	0.869%	0.879%	0.637%	0.747%
2019	0.848%	0.688%	0.598%	0.693%

Based on the above analysis, Wilary Winn lowers the interest rate of a 30-year loan by 0.875% and a 15-year loan lower by 0.625% to estimate the appropriate MBS coupon to use when applying a prepayment speed, e.g., a 30-year loan with a 3.875% interest rate equates to a 3.000% MBS.

DISCOUNT RATE

The final key element in valuing the MSR is the interest rate used to discount the future cash flows to present value. Wilary Winn uses a build-up method to derive the discount rate. We begin with the average of the 5-year and 10-year Treasury rates and add a spread for prepayment and default risk. As of December 31, 2022, we added 5.5 percent to the underlying risk-free rate. The discount rate is the least transparent input because the parties to bulk servicing trades are bound by confidentiality. Therefore, we benchmark our discount rate to the MSR surveys and to the rates we see used by other valuation firms.

As an additional step, we calculate the IRR of flow servicing released premiums. Purchasers of flow servicing will often underprice the value of the loan while overpricing the value of the servicing in their rate sheets. Due to this, Wilary Winn has performed an analysis to calculate the implied servicing value that the purchasers are paying for servicing. We have done this by comparing the all-in price (loan price plus service released premium) to a Freddie Mac loan price using five different institutions that purchase loans on a flow basis. The sample loan we used in this analysis was a $275,000 30-year fixed rate conventional loan with a 6.375% interest rate. Once we calculated the implied servicing values, we used our servicing model to solve for the required yield to obtain the implied servicing price. Below are the results of this analysis.

Required Yield on Implied Servicing Value			
Investor	Price	Implied Servicing	Required Yield
FHLMC Loan Price	101.316		
Chase All-in Price	101.998	0.682%	22.488%
PennyMac All-in Price	102.235	0.919%	12.317%
PHL All-in Price	102.424	1.108%	7.200%
Amerihome All-in Price	102.074	0.758%	18.553%
Citizens All-in Price	102.320	1.004%	9.792%

We note that each purchaser will have a different opinion regarding prepayment speeds, servicing cost, ancillary income, etc. Additionally, each purchaser will have a different appetite for certain types of loans at different times (30-year vs. 15-year, conventional vs. government, etc.) and they may price aggressively or

conservatively based on the types of loans they would like to acquire at any given time. We note that these yields are very wide and indicate that Chase, Amerihome, and, to a lesser extent, PennyMac are bidding very conservatively, while Citizens and PHL are pricing more aggressively. The median and average discount rates in the MSR assumption surveys for conforming conventional loans are 9.38% and 9.49%, respectively, in the first survey and 10.75% and 10.19%, respectively, in the second survey, which lie in the middle of these implied servicing yields.

Sensitivity Analysis

Certain input assumptions have a larger effect on MSR values than other assumptions. To show the relative effects of changes to the input assumptions on the overall MSR value, we have modeled seven different hypothetical loans. In each case, we are using an estimated market note rate for a 30-year loan as of March 31, 2023. We are using 30-year loans because they have the longest duration and will therefore show the largest change in value. We have included the most significant secondary market outlets to account for differences in remittance methods. We have also included a Fannie Mae and a Freddie Mac loan with escrows and another that is non-escrowed for taxes and insurance. We note our Ginnie Mae examples are based on an FHA-insured loan and a VA guaranteed loan. We have also included a Fannie Mae adjustable-rate mortgage ("ARM"). We note that we are assuming the loans are located in Minnesota, which affects our delinquency and float input assumptions.

Loan Attributes						
Investor	Loan Amount	Interest Rate	Fixed / ARM	Escrow	Guarantor	Remittance Method
FNMA	301,887	6.375%	Fixed	Yes	FNMA	A/A
FNMA	301,887	6.375%	Fixed	No	FNMA	A/A
FNMA	301,887	6.125%	ARM	No	FNMA	A/A
FHLMC	300,000	6.375%	Fixed	Yes	FHLMC	S/A
FHLMC	300,000	6.375%	Fixed	No	FHLMC	S/A
GNMA	279,900	6.250%	Fixed	Yes	FHA	S/S
GNMA	279,900	6.250%	Fixed	Yes	VA	S/S

PREPAYMENT SPEED ASSUMPTION FOR SENSITIVITY ANALYSES

Our assumption for prepayment speed is 12.218% for the Fannie Mae and Freddie Mac fixed rate loans, 21.152% for the Fannie Mae ARM loan, 17.660% for the Ginnie Mae FHA fixed rate loan, and 17.717% for the Ginnie Mae VA loan.

We hold these speeds constant for the input assumption shocks that follow. We show the prepayment shocks as the final input assumption on pages 10-11.

AVERAGE LOAN SIZE AND SERVICING INCOME

The loan sizes for Fannie Mae and Freddie Mac are based on their December 31, 2022, 10-K filings. The average loan size for Ginnie Mae originations is per Ginnie Mae's Global Markets Analysis Report, March 2023, page 27.

The servicing fee is 25 basis points for Fannie Mae and Freddie Mac fixed rate loans, 37.5 basis points for the Fannie Mae ARM, and 44 basis points for the Ginnie Mae Loans.

The following chart shows the change in the servicing value if we reduce the loan size by 20%.

Loan Size Down 20%				
Loan Detail	Base Value	Shocked Value	Bps Variance	% Change
FNMA w/Escrow	1.167%	1.149%	-0.018%	-1.575%
FNMA no Escrow	1.041%	1.023%	-0.018%	-1.765%
FNMA ARM	1.030%	1.016%	-0.013%	-1.302%
FHLMC w/Escrow	1.230%	1.212%	-0.018%	-1.504%
FHLMC no Escrow	1.104%	1.086%	-0.018%	-1.675%
GNMA FHA	1.601%	1.573%	-0.028%	-1.732%
GNMA VA	1.629%	1.605%	-0.024%	-1.463%

As one can see, a relatively large change in the size of the loan has a relatively modest effect on the overall MSR value.

ANCILLARY INCOME

Our ancillary income assumptions for these sample loans are $30 per loan per year for the FNMA and FHLMC loans and $40 per loan per year for the GNMA loans. The chart below details the change in the servicing value if we reduce the ancillary income assumption by 20%.

Ancillary Income Assumption Down 20%				
Loan Detail	Base Value	Shocked Value	Bps Variance	% Change
FNMA w/Escrow	1.167%	1.157%	-0.010%	-0.869%
FNMA no Escrow	1.041%	1.031%	-0.010%	-0.973%
FNMA ARM	1.030%	1.024%	-0.006%	-0.595%
FHLMC w/Escrow	1.230%	1.220%	-0.010%	-0.829%
FHLMC no Escrow	1.104%	1.094%	-0.010%	-0.924%
GNMA FHA	1.601%	1.591%	-0.010%	-0.645%
GNMA VA	1.629%	1.618%	-0.010%	-0.639%

The results show that a relatively large change in the ancillary input assumption has a relatively modest effect on the overall MSR value. To put this in additional context, according to the MSR surveys, the median annual ancillary income for a conforming conventional loan is $25.50 in the first survey and $34.00 in the second survey. The income input assumption at the 25th percentile of the first survey is $19.20, which is a difference of $6.30 or 24.7%. Our base ancillary income assumption for FNMA / FHLMC loans is $30 per year and our 20% decrease for the shock is $24 which is a difference of $6 per year. Our base ancillary income assumption for GNMA loans is $40 per year and our 20% decrease for the shock is $32, which is a difference of $8 per year. This shows that our decrease in ancillary income is relatively consist with the range of market ancillary income assumptions.

SERVICING COSTS

Our base servicing cost assumptions are $70 per loan per year for the Fannie Mae and Freddie Mac fixed rate loans, $75 per loan per year for the Fannie Mae ARM loan, and $80 per loan per year for the Ginnie Mae loans. The chart below details the change in the servicing value if we increase the servicing cost assumption by 20%.

Servicing Cost Assumption Up 20%				
Loan Detail	Base Value	Shocked Value	Bps Variance	% Change
FNMA w/Escrow	1.167%	1.143%	-0.024%	-2.048%
FNMA no Escrow	1.041%	1.018%	-0.024%	-2.295%
FNMA ARM	1.030%	1.014%	-0.016%	-1.517%
FHLMC w/Escrow	1.230%	1.206%	-0.024%	-1.956%
FHLMC no Escrow	1.104%	1.080%	-0.024%	-2.178%
GNMA FHA	1.601%	1.580%	-0.021%	-1.311%
GNMA VA	1.629%	1.608%	-0.021%	-1.298%

As detailed above, a relatively large change in the servicing cost input assumption has a relatively modest effect on the overall MSR value.

To put this in additional context, according to the MSR surveys, the median annual cost to service a current conforming conventional loan is $64.45 in the first survey and $72.50 in the second survey. The cost input assumption at the 75th percentile in the first survey is $67.75. Our base cost estimate is $70.00 and our 20% shock input assumption is $84.00, which is over four times the dollar size increase in moving from the median to the 75th percentile. This shows that our 20% increase in cost is a relatively large increase compared with the range of market cost input assumptions.

FORECLOSURE RATE

Our foreclosure rate assumptions for the loans are shown below based on the MBA delinquency study as of December 31, 2022, for loans located in Minnesota.

Foreclosure Rate		
Loan Detail	Base F/C Rate	2X F/C Rate
FNMA / FHLMC Fixed	0.140%	0.280%
FNMA ARM	0.340%	0.680%
GNMA FHA	0.940%	1.880%
GNMA VA	0.420%	0.840%

The chart on the following page details the change in the servicing value resulting from a doubling of the foreclosure rate assumption.

Foreclosure Rate Assumption 2X				
Loan Detail	Base Value	Shocked Value	Bps Variance	% Change
FNMA w/Escrow	1.167%	1.159%	-0.008%	-0.679%
FNMA no Escrow	1.041%	1.034%	-0.007%	-0.708%
FNMA ARM	1.030%	1.019%	-0.010%	-1.002%
FHLMC w/Escrow	1.230%	1.222%	-0.008%	-0.640%
FHLMC no Escrow	1.104%	1.097%	-0.007%	-0.664%
GNMA FHA	1.601%	1.523%	-0.078%	-4.865%
GNMA VA	1.629%	1.577%	-0.051%	-3.162%

The foreclosure rate assumption affects the GNMA loans the most because the base foreclosure rate is higher, but also because the required remittance method is scheduled principal and scheduled interest, meaning that the servicer must advance funds to the investor regardless of whether the borrower makes their payment. In addition, a loss on foreclosure is larger for GNMA loans based on how the guarantor, the FHA or VA reimburses the servicer.

LOSS ON FORECLOSURE

Our one-time foreclosure cost assumptions are $1,400 for the Fannie Mae and Freddie Mac loans, $4,500 for the FHA-insured Ginnie Mae loan, and $7,500 for the VA-guaranteed Ginnie Mae loan. Below, please find a chart detailing the change in the servicing value if we increase the foreclosure cost assumption by 20%.

Foreclosure Cost Assumption Up 20%				
Loan Detail	Base Value	Shocked Value	Bps Variance	% Change
FNMA w/Escrow	1.167%	1.167%	-0.001%	-0.055%
FNMA no Escrow	1.041%	1.041%	-0.001%	-0.061%
FNMA ARM	1.030%	1.029%	-0.001%	-0.091%
FHLMC w/Escrow	1.230%	1.230%	-0.001%	-0.052%
FHLMC no Escrow	1.104%	1.104%	-0.001%	-0.058%
GNMA FHA	1.601%	1.591%	-0.010%	-0.649%
GNMA VA	1.629%	1.621%	-0.008%	-0.482%

Not surprisingly, the largest effect is on the GNMA loans given that our base input loss and cost assumptions are both higher than the assumptions for conforming conventional loans. To put this in additional context, according to a Q3 2022 MSR assumption survey (the most recent survey we have with VA foreclosure cost assumptions included), the median cost of a foreclosure on a loan a VA loan is $7,065. The input assumption at the 75th percentile is $8,415. Our input was $7,500, which we increased to $9,000 in our shock. This shows that our 20% increase in cost is slightly higher, but relatively inline compared with the range of market cost input assumptions.

According to a Q3 2020 MSR survey (the most recent survey we have with FHA foreclosure cost assumptions included), the median cost of a foreclosure on an FHA insured is $4,300. The input assumption at the 75th

percentile is $5,312. Our input was $4,500, which we increased to $5,400 in our shock. This shows that our 20% increase in cost is relatively inline compared with the range of market cost input assumptions.

Finally, we note that based on the modest rates of delinquency for loans located in Minnesota, the change in the foreclosure loss input assumption does not significantly affect the overall MSR value. At December 31, 2022, the Minnesota delinquency rates were approximately 73% of the national average delinquency rates for fixed rate conventional loans.

FLOAT EARNINGS

Our assumption for the T & I payment is $622 for the Fannie Mae escrowed loan, $618 for the Freddie Mac escrowed loan, and $569 for the FHA and VA loans. We are assuming the loans are located in Minnesota. The tax payments are therefore due semi-annually and there is no requirement to pay the borrower any interest on their escrow balance. Below, please find a chart detailing the change in the servicing value if we reduce the escrow payment by 20%.

Escrow Payment Assumption Down 20%				
Loan Detail	Base Value	Shocked Value	Bps Variance	% Change
FNMA w/Escrow	1.167%	1.142%	-0.025%	-2.155%
FNMA no Escrow	1.041%	1.041%	0.000%	0.000%
FNMA ARM	1.030%	1.030%	0.000%	0.000%
FHLMC w/Escrow	1.230%	1.205%	-0.025%	-2.044%
FHLMC no Escrow	1.104%	1.104%	0.000%	0.000%
GNMA FHA	1.601%	1.582%	-0.019%	-1.160%
GNMA VA	1.629%	1.610%	-0.019%	-1.148%

Wilary Winn uses the SOFR forward curve to forecast the interest rate earned on float arising from the P&I payments and escrow payments. With interest rates having risen substantially in 2022 to be more in line with historical norms, the impact of float on the value of MSRs has increased since December 31, 2021. The chart below shows the effect of increasing the SOFR forward curve by 2 percent.

SOFR Curve + 2.00% in all periods				
Loan Detail	Base Value	Shocked Value	Bps Variance	% Change
FNMA w/Escrow	1.167%	1.238%	0.070%	6.027%
FNMA no Escrow	1.041%	1.046%	0.005%	0.470%
FNMA ARM	1.030%	1.034%	0.005%	0.459%
FHLMC w/Escrow	1.230%	1.334%	0.104%	8.429%
FHLMC no Escrow	1.104%	1.143%	0.038%	3.463%
GNMA FHA	1.601%	1.731%	0.130%	8.099%
GNMA VA	1.629%	1.759%	0.131%	8.034%

This change has a relatively large effect on the overall value of the MSR asset for loans that escrow and a much more modest impact for loans that do not escrow. Although SOFR is not perfectly correlated with

treasury and mortgage rates, it would be expected that other interest rates would show an increase similar to what we've incorporated in this shock scenario.

DISCOUNT RATE

Our discount rate assumptions at March 31, 2023 are 9.00% for the Fannie Mae and Freddie Mac fixed-rate loans, 11.00% for the Fannie Mae ARM loan, and 10.50% for the Ginnie Mae loans. The chart below details the change in the servicing value if we increase the discount rate assumption by 20%.

Discount Rate Assumption Up 20%				
Loan Detail	Base Value	Shocked Value	Bps Variance	% Change
FNMA w/Escrow	1.167%	1.093%	-0.074%	-6.359%
FNMA no Escrow	1.041%	0.976%	-0.066%	-6.334%
FNMA ARM	1.030%	0.986%	-0.043%	-4.192%
FHLMC w/Escrow	1.230%	1.152%	-0.078%	-6.369%
FHLMC no Escrow	1.104%	1.034%	-0.070%	-6.347%
GNMA FHA	1.601%	1.526%	-0.075%	-4.681%
GNMA VA	1.629%	1.552%	-0.077%	-4.732%

The results show that the discount rate used has a significant effect on the overall value of the MSR asset. To put this in additional context, according to the MSR surveys, the median discount rate (for firms using a static rate vs. OAS) is 9.40% in the first survey and 10.75% in the second survey. The input assumption at the 75th percentile of the first survey is 9.79% and the maximum was 10.79%. Our input assumption is 9.00% and our shock input assumption is 10.80% which is in line with the maximum rate in the first survey.

This shows that our 20% increase in rate is in line with the increase compared with the range of market discount rate input assumptions.

PREPAYMENT SHOCK ANALYSES

To demonstrate the effect of the prepayment speed assumption on the overall value, we developed two shock analyses. In the first example, we simply increase our prepayment speed assumption by 20%.

Prepayment Assumptions Up 20%				
Loan Detail	Base Value	Shocked Value	Bps Variance	% Change
FNMA w/Escrow	1.167%	1.070%	-0.097%	-8.313%
FNMA no Escrow	1.041%	0.955%	-0.086%	-8.258%
FNMA ARM	1.030%	0.923%	-0.107%	-10.384%
FHLMC w/Escrow	1.230%	1.132%	-0.098%	-7.994%
FHLMC no Escrow	1.104%	1.017%	-0.087%	-7.906%
GNMA FHA	1.601%	1.480%	-0.121%	-7.569%
GNMA VA	1.629%	1.503%	-0.126%	-7.735%

The results show that the prepayment speed input has a significant effect on the MSR fair value.
In the second example, we assume that market interest rates fall by one-half of one percent. The table below shows the base prepayment assumption and the assumption if rates fall 50 basis points using the market prepayment speeds from the MIAC model. In the example below, if interest rates decreased 50 basis points, the prepayment rate for the sample FNMA and FHLMC fixed rate loans would increase from 12.218% to 19.418% (an increase of 7.200% or 58.9%).

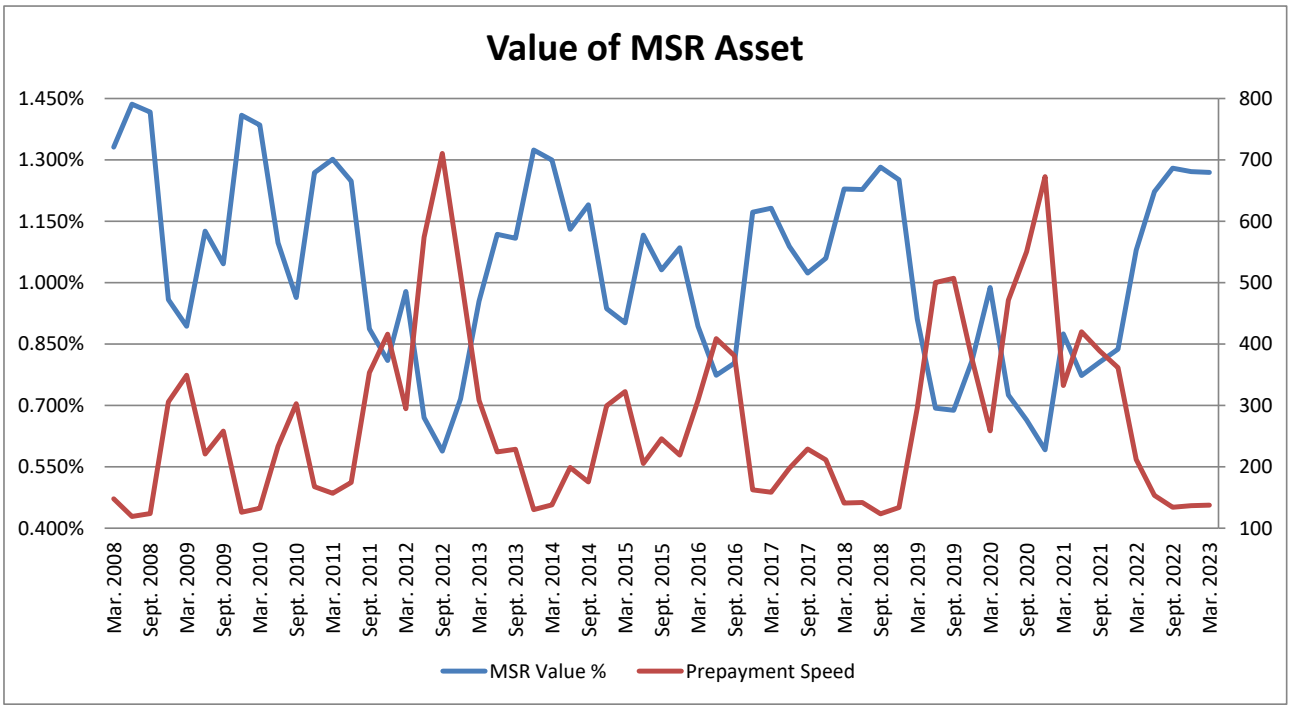
Prepayment Assumptions -50 Basis Point Shock				
Loan Detail	Base CPR %	-50 Bps CPR %	CPR % Increase	% Change
FNMA w/Escrow	12.218%	19.418%	7.199%	58.925%
FNMA no Escrow	12.218%	19.418%	7.199%	58.925%
FNMA ARM	21.152%	N/A	N/A	N/A
FHLMC w/Escrow	12.218%	19.418%	7.199%	58.925%
FHLMC no Escrow	12.218%	19.418%	7.199%	58.925%
GNMA FHA	17.660%	22.097%	4.437%	25.125%
GNMA VA	17.717%	22.150%	4.434%	25.025%

The interest rate shocks are assumed to be an instantaneous, parallel, and sustained shift in the yield curve. The assumed decrease in interest rates and the corresponding increase in prepayment speeds has the following effect on MSR values.

Prepayment Assumptions -50 Basis Point Shock				
Loan Detail	Base Value	Shocked Value	Bps Variance	% Change
FNMA w/Escrow	1.167%	0.868%	-0.299%	-25.606%
FNMA no Escrow	1.041%	0.786%	-0.256%	-24.551%
FNMA ARM	1.030%	N/A	N/A	N/A
FHLMC w/Escrow	1.230%	0.921%	-0.309%	-25.150%
FHLMC no Escrow	1.104%	0.838%	-0.266%	-24.104%
GNMA FHA	1.601%	1.385%	-0.216%	-13.473%
GNMA VA	1.629%	1.405%	-0.223%	-13.704%

The results show that even a modest decrease in market interest rates has a significant effect on the prepayment speed assumption, increasing the speeds by more than our 20% shock assumption and significantly changing the overall value of the MSR asset. We also note that this impact is related to newly originated loans and that the impact on most existing MSR portfolios with weighted average interest rates less than 4.00% would not be impacted nearly as much by a 50-basis point decline in mortgage rates.

We further note that market interest changes can regularly change by more than 50 basis points. The table on the following page shows the effect of changes in the prepayment speed on the value of the MSR asset from March of 2008 to March of 2023.



Because the prepayment speed assumption is such a critical input assumption, we routinely include prepayment shock analyses in our valuation reports.

Loan Attributes

In our data requests we ask for numerous loan attributes. An example data request is attached as Appendix B.

Certain attributes are more important than others because the attribute is related to an important valuation input assumption. The most important attributes are related to the prepayment speed assumption and include:

- Loan amount
- Note rate
- Original loan term
- Year of origination
- Investor
- Given the increase in interest rates in 2022, whether the loan is escrowed or not, and the state where the loan is located if it is escrowed.

While we did not shock the servicing fee, it is also an important loan attribute.

Loan attributes with relatively less importance include:

- The investor remittance method

Conclusion

Given the volatility that regularly occurs with mortgage interest rates, it is important for mortgage servicers to understand the impact that these changes have on their mortgage servicing rights assets and the related impact to their financial statements.

Appendix A – MIAC Conventional 30 Year Prepayment Speed Sample

Agency	PSA_Coupon	PSA_IssueYear	PSA -200	PSA -100	PSA -50	PSA - Base	PSA +50	PSA +100	PSA +200
CONV 30	1.5	2020	114	108	106	106	106	106	106
CONV 30	1.5	2021	110	103	103	103	103	103	103
CONV 30	2	2020	105	105	105	105	105	105	105
CONV 30	2	2021	100	98	98	98	98	98	98
CONV 30	2	2022	144	130	123	121	121	121	121
CONV 30	2.5	2013	116	104	98	95	95	95	95
CONV 30	2.5	2016	119	108	102	96	96	96	96
CONV 30	2.5	2019	123	108	101	95	92	91	90
CONV 30	2.5	2020	117	117	112	105	105	105	105
CONV 30	2.5	2021	127	115	108	103	101	99	98
CONV 30	2.5	2022	153	138	131	124	124	124	124
CONV 30	3	2012	127	114	109	103	99	98	96
CONV 30	3	2013	125	113	107	101	98	96	95
CONV 30	3	2014	133	106	101	96	92	92	92
CONV 30	3	2015	134	115	109	103	98	96	94
CONV 30	3	2016	137	117	109	103	98	97	97
CONV 30	3	2017	131	111	105	99	95	93	91
CONV 30	3	2018	144	117	115	112	110	110	110
CONV 30	3	2019	139	120	111	106	100	100	100
CONV 30	3	2020	145	122	115	109	103	103	103
CONV 30	3	2021	172	143	136	129	125	125	125
CONV 30	3	2022	188	146	139	131	126	125	125
CONV 30	3.5	2011	125	115	110	105	100	97	96
CONV 30	3.5	2012	131	123	117	111	106	102	99
CONV 30	3.5	2013	128	115	110	104	99	97	95
CONV 30	3.5	2014	137	121	114	108	103	98	96
CONV 30	3.5	2015	138	120	113	107	102	98	96
CONV 30	3.5	2016	142	124	115	108	102	98	98
CONV 30	3.5	2017	149	129	118	110	104	99	96
CONV 30	3.5	2018	154	129	119	110	103	97	95
CONV 30	3.5	2019	169	140	124	113	106	101	101
CONV 30	3.5	2020	157	129	118	110	103	98	96
CONV 30	3.5	2021	210	160	153	146	139	133	132
CONV 30	3.5	2022	230	155	147	140	132	127	127
CONV 30	4	2009	113	100	99	95	92	89	88
CONV 30	4	2010	128	121	116	111	106	102	99
CONV 30	4	2011	127	120	114	109	104	100	97
CONV 30	4	2012	136	121	114	109	104	99	97
CONV 30	4	2013	140	123	115	109	104	100	97
CONV 30	4	2014	149	126	116	110	105	100	97
CONV 30	4	2015	145	128	119	112	107	101	98
CONV 30	4	2016	146	129	120	113	107	102	99
CONV 30	4	2017	161	140	127	117	109	103	99
CONV 30	4	2018	180	141	133	122	113	106	100
CONV 30	4	2019	185	145	133	124	114	106	101
CONV 30	4	2020	193	149	131	120	112	106	101
CONV 30	4	2021	291	188	164	157	150	143	137
CONV 30	4	2022	475	200	157	150	142	134	127
CONV 30	4.5	2009	147	97	102	99	96	93	89
CONV 30	4.5	2010	146	121	120	116	111	107	102
CONV 30	4.5	2011	142	121	119	114	109	105	100
CONV 30	4.5	2013	162	112	113	107	103	99	93
CONV 30	4.5	2014	162	115	114	107	103	100	94
CONV 30	4.5	2016	171	135	128	122	116	111	104
CONV 30	4.5	2017	179	144	132	122	115	109	103
CONV 30	4.5	2018	219	171	152	137	125	116	109
CONV 30	4.5	2019	231	180	156	141	127	117	109
CONV 30	4.5	2020	253	156	147	134	128	122	113
CONV 30	4.5	2022	968	247	205	159	151	144	129
CONV 30	4.5	2023	1074	211	162	146	146	139	125
CONV 30	5	2010	156	116	120	120	115	111	105
CONV 30	5	2011	160	87	104	107	103	100	92
CONV 30	5	2018	223	173	151	142	130	121	113
CONV 30	5	2019	258	185	160	149	136	126	117
CONV 30	5	2022	1186	447	247	204	162	153	138
CONV 30	5	2023	1667	515	225	188	156	148	132
CONV 30	5.5	2022	1366	823	441	247	203	163	146
CONV 30	5.5	2023	1667	1159	522	246	199	158	142
CONV 30	6	2022	1190	959	692	397	225	185	137
CONV 30	6	2023	1515	1188	813	434	214	173	131
CONV 30	6.5	2022	1115	970	890	636	366	215	139

Appendix A – MIAC Conventional 15 Year Prepayment Speed Sample

Agency	PSA_Coupon	PSA_IssueYear	PSA -200	PSA -100	PSA -50	PSA - Base	PSA +50	PSA +100	PSA +200
CONV 15	1	2021	131	118	114	114	114	114	114
CONV 15	1.5	2020	117	111	107	106	106	106	106
CONV 15	1.5	2021	117	110	107	107	107	107	107
CONV 15	1.5	2022	144	130	123	121	121	121	121
CONV 15	2	2016	127	117	110	104	101	99	97
CONV 15	2	2019	124	107	102	97	95	95	95
CONV 15	2	2020	132	116	113	104	101	101	101
CONV 15	2	2021	136	123	111	105	105	105	105
CONV 15	2	2022	152	137	130	122	122	122	122
CONV 15	2.5	2015	133	124	117	111	106	103	100
CONV 15	2.5	2016	143	133	125	117	111	106	102
CONV 15	2.5	2017	132	120	113	107	101	98	96
CONV 15	2.5	2019	145	121	121	116	108	101	97
CONV 15	2.5	2020	141	121	121	112	103	98	98
CONV 15	2.5	2021	154	136	129	122	117	117	117
CONV 15	2.5	2022	176	145	138	130	124	123	123
CONV 15	3	2017	158	133	133	126	118	111	106
CONV 15	3	2018	167	133	133	127	118	111	105
CONV 15	3	2019	148	123	120	118	115	113	112
CONV 15	3	2020	152	128	125	122	119	116	116
CONV 15	3	2021	148	148	141	135	128	121	120
CONV 15	3	2022	207	157	149	141	134	126	125
CONV 15	3.5	2018	176	135	120	118	116	114	112
CONV 15	3.5	2019	174	139	124	122	119	117	114
CONV 15	3.5	2020	174	143	130	127	124	122	119
CONV 15	3.5	2022	455	198	164	152	144	136	127
CONV 15	4	2022	555	270	200	169	153	146	130
CONV 15	4	2023	707	314	200	165	153	145	129
CONV 15	4.5	2022	648	377	204	184	155	146	131
CONV 15	4.5	2023	1006	548	305	207	166	147	131
CONV 15	5	2022	805	509	430	226	197	166	147
CONV 15	5	2023	971	644	491	301	200	160	133

Appendix B – Data Request Sample

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Standard Data Requests - if a requested item is unavailable or not applicable, the column can remain blank

1. Loan # or a unique identifier for each loan that will remain consistent throughout time
2. Current Unpaid Principal Balance
3. Original Unpaid Principal Balance
4. Property Location State
5. Interest Rate
6. Servicing Fee - net of guarantee fee if applicable
7. Principal and Interest Monthly Payment Amount
8. Tax and Insurance Monthly Payment Amount
9. Do you pay interest on the mortgagor's escrow balances and, if so, at what rate of interest? Does it differ based on the state where the properties are located, is it a static rate across all mortgages with escrow, etc.?
10. Type of Loan (30 Year fixed, 5/1 ARM, VA, FHA, Balloon etc.)
11. Origination Date
12. 1st Payment Date
13. Maturity Date
14. Term
15. Weighted Average Maturity (Number of months remaining in the term) *we can calculate as long as we have maturity dates
16. Age of the Loan in months *we can calculate as long as we have 1st payment dates
17. Investor (FHLB, FNMA, FHLMC, Private, CHFA, etc.)
18. If FHLB - which MPF Program (or Master Commitment # if available) does each loan belong in (MPF 35, MPF 100, MPF 125, MPF Original, MPF Government, MPF Xtra, etc.)
19. Investor Remittance Method (Interest & Principal - Scheduled versus Actual)
    *Scheduled/Scheduled, Scheduled/Actual, Actual/Actual, Actual/Actual Daily, Actual/Actual Single, Actual/Actual Multiple, Actual every 15th of the month, Scheduled every 1st of the month, etc.
20. What specific day(s)/date(s) of the month are P & I and payoffs remitted to the investor(s)?
21. Identify loans originated under the revised version of HARP

We need the following information related to non-performing loans:

22. Delinquency Status (Days DQ - 30, 60, 90, Foreclosure, etc.) or Next Payment Due Date
23. Any mortgagors in bankruptcy

We need the following information for any balloon loans:

24. Time period for amortization
25. Date of balloon payment

We need the following additional items needed if any of the loans are ARM's:

26. Margin
27. Index (Prime, 1 Yr T-bill, COFI, etc.)
28. Months to First Interest Rate Adjustment or Date of First Interest Rate Adjustment
29. Interest Rate Adjustment Frequency
30. Initial Interest Rate Cap
31. Subsequent Interest Rate Cap
32. Maximum interest rate or Maximum total adjustment