MountainView
Risk Advisors, LLC

MSR Hedging Costs

Measuring and Forecasting

A MountainView White Paper

While most large holders of MSR portfolios have implemented capital markets offsets of MSR risk, there is no typical framework for forecasting hedge results and measuring hedge effectiveness. Greg Harris of MountainView Risk Advisors examines this issue and recommends an evaluation framework.

Returns associated with holding the mortgage servicing rights (MSR) asset are among the most volatile of any financial derivative instrument. MSR represents a portion of the interest-only (IO) strip on a portfolio of mortgage loans, plus ancillary cash flows. MSRs, like IOs, concentrate the risks associated with the prepayment option embedded in almost all residential mortgages, creating an asset with highly negative duration and convexity.

The purpose of the capital markets hedge of MSR fair value is to mitigate the volatility associated with this asset. Considering the current regulatory environment and scrutiny of risk, we believe the volatility of the capitalized MSR asset cannot be ignored by institutions looking to maximize their risk-adjusted returns.

Author

Greg Harris is a managing director at MountainView Risk Advisors. Mr. Harris has 20 years of experience hedging the risks associated with mortgage servicing rights. Greg's roles have ranged from trading interest rate securities and derivatives to managing the MSR hedging effort at three top-10 servicers. In these roles, his responsibilities have included leadership in the development of analytical techniques for evaluating and reporting risk in the MSR asset, as well as implementing and managing the hedge.

There are several methods for estimating MSR hedging costs. One method is recommended here, and its steps are discussed in detail on the following pages.

Evaluation and Forecasting Steps

1. Create the framework. Define which risks the hedge is designed to offset and establish reasonable expectations of performance.

2. Define the MSR risk drivers: duration, convexity, basis, curve and volatility.

3. Identify the value of the prepayment option. Dimension the market-determined value of the risk. The primary determinant of MSR hedge costs is the value of the homeowner's right to prepay the mortgage. Calculating the yield value of this option is the first step in determining the cost of hedging this asset.

4. Apply an option value estimate. Establish an estimate of the cost of hedging the option based on your hedging strategy. The complexity of the hedge offset will be determined by your risk tolerance.

    - Consider the cost implications of the options offset and dynamic delta hedging.

    - Identify a reasonable range of expected results. Consider the uncertainty associated with delta hedging and residual risks such as basis and volatility.

5. Measure and analyze performance. Implement a robust attribution of results to identify sources of hedge inefficiency.

Planning for the financial impact of MSR hedging is crucial to business results.

Create the Framework

The goal of the MSR hedge is to offset the decline in the fair value of MSR due to changes in market factors, such as interest rates, spreads, and implied volatility. It is important to begin by defining what is viewed as the hedgeable portion of asset risk.

Changes in MSR values from period to period fall into several general categories:

- Change (+ or -) due to market-based model inputs, such as interest rates, mortgage basis, yield curve slope, and volatility.
- Change (+ or -) in valuation assumptions, such as prepayment models and ancillary costs and revenues.
- Expected portfolio runoff (-).
- New capitalizations (+).

Capital market offsets of MSR value changes generally focus on the first category: change due to market-based model inputs. To the extent that assumptions regarding ancillary income and expenses are driven by tradeable markets, they are typically included, however drivers such as defaults are typically considered unhedgeable.

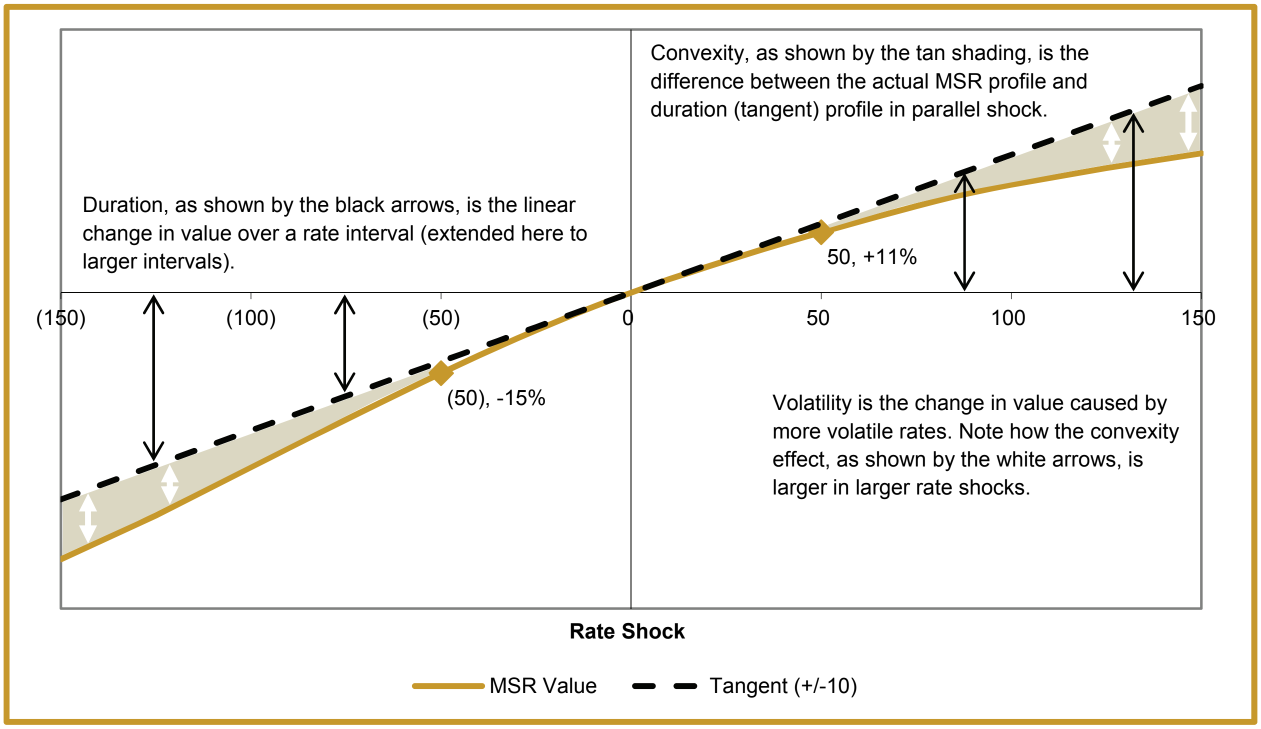
Expected portfolio runoff is the modeled amortization of the cash flows through time, while the timing of inclusion of the value of new MSR capitalization depends on the process and data flow of the servicer. In some cases, a portion of the future expected MSRs in loan commitments or originations (before securitization) is included in the assessment of value and therefore in the hedging process. After securitization but before loans appear in the MSR portfolio (tape is usually cut once per month), servicers may elect to hedge the new MSR. Though expected runoff is not considered hedgeable, excess runoff (above that projected by the model) is sometimes considered a hedgeable item.

Define the MSR Risk Drivers

Hedge costs in MSR arise from the fact that the value of the asset typically decreases more for a specific decline in interest rates than it increases for an equivalent rise in rates. This effect is driven by the asymmetric response of homeowner prepayments to changes in interest rates: rising more for a decline in rates than for a fall in a rate rise of the same magnitude. It is the value of this prepayment option, owned by the homeowner, which dominates the costs associated with MSR hedging.

Figure 1 illustrates the shape of the MSR value function (y axis) with respect to parallel changes in interest rates (x axis). Note that, in this example, for a 50bp decline in rates, the value decreases roughly 1/3 more than it increases for a 50bp rise in rates, which is typical of an asset with optionality.

Figure 1: MSR Value Changes in Response to Interest Rate Changes



The primary cost associated with hedging MSR is primarily driven by the cost associated with hedging convexity.

The gold line represents the value profile of the MSR asset. To separate the value profile due to duration and convexity, the dashed black line represents the tangent line at the zero rate shock point. This measures the portion of the value change which is attributable to the duration of the portfolio (linear risk).

The difference between the value profile and the tangent line (tan shading) is the effect of convexity, the asymmetric impact of the homeowner’s prepayment option. Notice its effect is negative in either a rate increase or decrease.

Also of note is that the magnitude of the negative impact of convexity on value is larger with larger changes in interest rates (white arrows). This is the impact of market volatility: as volatility increases, additional negative convexity is embedded into the price.

The illustration depicts MSR fair value risk relative to parallel shifts in interest rates. The MSR is sensitive to a variety of rates, including the mortgage Current Coupon and several points across the benchmark LIBOR curve. The extent to which hedges do not precisely offset the mortgage and curve exposure of the MSR, basis and curve risks are introduced.

The duration of the portfolio is typically offset by buying agency mortgage TBAs, receiver swaps, or Treasuries. Convexity can be offset either through option purchases, which also provide volatility coverage, or by periodically adjusting the duration of the hedge portfolio to match the asset (delta hedging). Basis risk is offset via a mortgage component within the hedge (typically TBAs), while curve risk is addressed by matching duration risk coverage to the exposure of the MSR.

Identify the Value of the Prepayment Option

As variabilty of hedge costs are driven in majority by the negative convexity of the MSR asset, derived from the homeowner's option to prepay the mortgage, it follows that the value of the option should be the starting point in estimating the cost to hedge MSRs. To use the option value for this purpose, you must convert it to a yield. There are two challenges associated with this approach: the option is not priced separately from the rest of the MSR; and if the price of the option is known, it needs to be spread across an uncertain and dynamic maturity.

Determining the yield value of the option is the foundation of the analytical approach and is dependent upon the valuation framework utilized. In the stochastic process, the future path of benchmark interest rates is projected across a number of scenarios using a random probabalistic process, calculated from the implied forward curve and the option implied volatility surface. The expected benchmark rates are then linked to the homeowner's ability to refinance via a mortgage rate model, which defines the relationship of the mortgage market to the underlying rates market. MSR cash flows are generated based on these estimates and the MSR price is then implied from benchmark rates plus a spread, referred to as the option adjusted spread (OAS).

Because volatility of future rate paths is what determines the option value, the yield value of the option can be solved for by comparing the spread implied by the stochastic process, current fair value price, and implied volatility versus the same model and price with volatility set to zero. The difference between the spreads is the implied option cost.

> Option Cost = Option Adjusted Spread
> - Zero Volatility Option Adjusted Spread

Quantification of the option value is less common in the static valuation and risk profiling framework, because this framework is based on current observable interest rates without considering multiple simulations in a risk-neutral framework.

It is possible, however, to estimate the yield value of the option over a limited horizon, utilizing the convexity profile of the MSR over the rate interval consistent with the implied volatility projected over the desired time interval. The calculation form can be summarized as:

> Option Value = Effect of Convexity ($/bp)
> * Volatility (bp/day) * Time Factor

The result of the equation is the dollar cost of the current level of convexity given the current level of implied volatility. It would be intuitively appealing to solve for the option cost by changing the discount rate to produce the value of the MSR less the option dollar cost. However, because of the extreme variability of the convexity level in a static analysis and the lack of a mechanism to capture the dynamic nature of the cash flows, this method is discouraged. Instead, MountainView recommends treating the result of the above calculation as an estimate of its effect over a limited horizon, defined by the time factor, which also drives the appropriate volatility assumption.

There are two key differences between the static and stochastic approaches.

1. The MSR in a static framework has a more variable convexity profile. Its convexity can swing from very negative to positive over a relatively narrow interest rate interval. Additionally, the convexity cost is usually larger in the static modeling assumption versus the stochastic model.

2. The static model evaluates the MSR versus current interest rates, while the stochastic approach bases its sensitivity on the implied risk-neutral forward curve. The implication is that in the static environment, the carry on the hedge instruments is based on spot rates, and is therefore usually higher, serving as an offset to the usually higher convexity cost. In the stochastic environment, hedge carry should be measured versus the forward curve and is therefore usually smaller while convexity cost is usually lower.

Apply an Option Value Estimate

Measuring the value of the options embedded in the MSR asset is a critical step toward understanding the cost of hedging the asset, but assigning 100 percent of the yield value of the option as its hedging cost is unrealistic. Measures of option cost will typically yield estimates in the hundreds of basis points in yield, potentially making the cost of owning and hedging MSR impractical. In addition to the cost impracticality, assuming the full option cost as the hedging budget implies that all of the market risk associated with the MSR has been eliminated, which is incorrect.

The estimate of option value previously referenced assumes that options are purchased to offset 100% of the negative convexity associated with the asset and that the options purchased replicate the convexity profile of the asset. The cost of options can be thought of as a form of insurance, and therefore it is not surprising that option prices embed a premium (over the cost of replicating the exposure profile) to compensate for the reduced risk. This is reflected in a historical 10 percent to 15 percent higher implied volatility for the options compared to realized volatility. Additionally, much of the day-to-day volatility associated with interest rates can be considered “noise,” fluctuating within a range.

Reducing the cost of offsetting convexity is the key to reducing hedge costs. Because the cost of insurance (in the form of options) usually sells at a premium to market volatility, most servicing hedgers usually offset only a portion of the convexity exposure by purchasing options, choosing to hedge the remainder of the optionality by adjusting the duration exposure of the hedge as rates fluctuate (delta hedging), usually based upon a decision rule.

The benefit of the lower cost of delta hedging convexity is not without risk: the higher the portion of the risk offset via delta hedging, the more variable (positive or negative) the realized results will be. Within the hedge cost forecasting framework, this tradeoff drives the projected cost of hedging based on:

1. The likely realized cost of offsetting the option through a delta hedge offset or a combination of options and delta hedge offset (recommended);

2. A sensitivity range of the results based on the potential volatility of rates operating on the unhedged convexity (delta hedged) and other market factors.

Figure 2 illustrates the results associated with a simple delta hedging example, and Figure 3 illustrates the tradeoff associated with various delta hedging rebalancing thresholds based on historical market activity. The graph summarizes the 2001-2009 average results associated with rebalancing duration only when the cumulative change in rates since the last rebalance exceeds the threshold on the X axis. A zero threshold indicates rebalancing duration on a daily basis.

Figure 2: MSR Delta Hedging Example

MSR Rate Sensitivity ($MM)			
Rate Shock	**MSR Value Change**	**Duration Hedge Value Change**	**Convexity Effect**
(30)	(121)	111	(10)
(25)	(99)	93	(6)
(20)	(78)	74	(4)
(15)	(58)	56	(2)
(10)	(38)	37	(1)
(5)	(19)	19	-
-	-	-	-
5	18	(19)	(1)
10	35	(37)	(2)
15	52	(56)	(4)
20	69	(74)	(5)
25	85	(93)	(8)
30	101	(111)	(10)

Interest Rate Scenarios

Scenario 1: Rates decrease 15bp and then increase 15bp.

- With no rebalancing, there is zero p/(l) impact.
- Rebalancing every 15bp, duration will be adjusted after Period 1, convexity losses are incurred in both periods, and total p/(l) is (4MM).

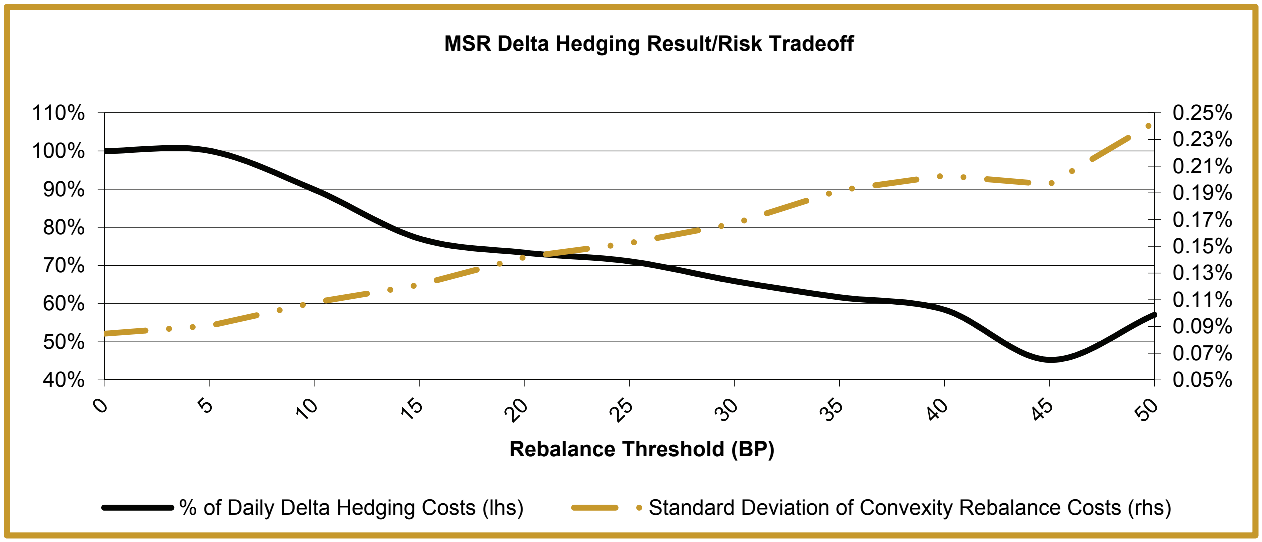
Scenario 2: Rates decrease 15bp, then decrease an additional 15bp.

- With no rebalancing, total p/(l) is (10MM).
- With rebalancing every 15bp, total p/(l) is (5MM).

Tighter rebalancing rules result in more frequent but smaller losses than no rebalancing.

	Scenario 1			**Scenario 2**		
Time Period	**Rate Change**	**P/(L) No Rebalancing**	**P/(L) Rebalancing Every 15bp**	**Rate Change**	**P/(L) No Rebalancing**	**P/(L) Rebalancing Every 15bp**
1	(15)	(2)	(2)	(15)	(2)	(2)
2	15	2	(2)	(15)	(8)	(3)
Total		**-**	**(4)**		**(10)**	**(5)**

Figure 3: MSR Delta Hedging Result/Risk Tradeoff



The analysis in Figure 3 suggests that by rebalancing duration only after a cumulative interest rate change of 15bp from the previous adjustment, the hedge manager can, on average, save 24% of the cost of hedging the option. The risk associated with this strategy is that on average, the convexity losses locked in each time the hedge is rebalanced will be approximately 0.13 percent of the asset value.

The larger the threshold, the greater the chance of a large loss. The risk tolerance of the individual institution will determine the appropriate rebalancing threshold, which will, in turn, influence the expected cost of hedging.

Measure and Analyze Performance

In this framework, hedge costs are estimated based on the interest rate risk profile of the MSR, market implied volatility of interest rates, and the construction of the MSR hedge. The effectiveness will vary, positive or negative, from the forecast based on a number of factors, including the realized volatility of interest rates and the residual risks (e.g. basis and yield curve).

It is important to analyze this variance by measuring the sources of the change in value of the MSR and related hedges. Using the risk metrics calculated in the MSR portfolio analytics process, applied to the market environment, the sources of variance to the hedge cost estimate can be identified.

This process creates an important feedback loop, providing confirmation of the effectiveness of the risk modeling, while facilitating discussion of the risks and opportunities associated with the hedge strategy.

Summary

We suggest the following steps for estimating the cost of hedging a specific MSR portfolio:

- Calculate the yield value of the prepayment option convexity cost (in basis points).
    - Stochastic Model: Option Cost = ZVOAS - OAS
    - Static model: Option Cost = Convexity ($/bp) * Implied Volatility (bp/day) * Time (√days) [converted to yield]
- Apply the percentage of convexity (e.g. 40 percent) expected to be offset with options to the options cost calculated in the previous step.
- For the portion of the convexity not covered by the options, factor the prepayment option cost lower based on two drivers:
    1. The historical discount of realized volatility to option implied volatility, which typically is approximately 15 percent.
    2. The anticipated cost savings due to the implementation of the delta hedging adjustment tolerance.
- Estimate hedge carry as a partial offset to convexity cost.
- Identify an expected range around the estimate based on potential inefficiency of the delta hedge offset.
- Include potential for volatility of hedge offset due to risks associated with the strategy, such as mortgage basis, curve volatility, and changes in implied volatility.
- Attribute the change in value of MSR and related hedges to market drivers of risk. Use the analysis to refine risk measures and to evaluate strategy.

MountainView Risk Advisors is the MSR risk management subsidiary of MountainView Capital Holdings, a financial services firm focused on the diverse needs of participants in the mortgage and fixed income capital markets. With expertise in asset management, valuation, risk management, trading, marketing and sales, MountainView is uniquely qualified to create value in all market conditions, and we continue to build on our longstanding commitment to offer a broad range of services.

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