DURATIONS TO SUCCESSFULLY HEDGING MORTGAGE PIPELINES

WHITE PAPER

OPTIMALBLUE
A DIVISION OF BLACK KNIGHT

DURATIONS TO SUCCESSFULLY HEDGING MORTGAGE PIPELINES

By Mike Vough, Edoardo Cicchella and Toby Huskinson

We've recently seen increased volatility in the mortgage market, so it's a good time to review the basics of hedging and risk management. Today, mortgage originators have a virtually constant flow of mortgages to be hedged in order to protect projected profit margins. And in the current rate environment, the UM30 2.5 decreased more than two points in January 2022. Mortgage servicing rights (MSR) valuations are at highs not seen in years, and profit margins have shrunk to lows not seen in years of which are causing hectic times for mortgage pipeline hedgers. This is due to hedgers having multiple things to consider, including what is happening in the market, interest rate sensitivity of specified/special products, impact of the servicing valuation, and portfolio cross hedges to succeed in today's volatile markets.

When hedging mortgage originations with to-be-announced mortgage-backed securities (TBAs), you have to pay strict attention to various nuances of the loan asset. Consider the simple example below.

If a lender is hedging $1 million of loan production slotting to the UM30 2.5, the hedger could forward-sell $1 million UM30 2.5 settling in two months to hedge the interest rate risk the lender is exposed to during underwriting. Ignoring subtle variances between different types of loans could lead to over- or under-hedging the pipeline. That can lead to unexpected profit and loss volatility, especially if a position is slowly making or losing money.

To adequately discuss the differences between loans, understanding how a loan is valued is critical. When pricing a mortgage, cash flows are amortized throughout the life of the loan. These cash flows begin with note rate payments from the borrower and are passed from the servicer to MBS holders. The note rate is segmented into servicing fees and guarantee fees, and is eventually paid back to bondholders in the form of MBS coupons. The present value of all collected MBS coupon payments derives the value of the mortgage.

The original term of the cash flow schedule (often 360 or 180 months) is typically cut short by prepayment activity, often in the form of a mortgage refinance by the borrower. It is extremely rare to see a mortgage make it to term, as the borrower is economically incentivized to refinance when rates are low. At origination, the actual term of the mortgage is unknown, since interest rate changes that drive refinancing decisions have not yet occurred.

MONTH	OUTSTANDING BALANCE	CPR	SMM	MORTGAGE PAYMENT	INTEREST	SCHEDULED PRINCIPAL	PREPAYMENT	TOTAL PRINCIPAL	TOTAL CASH FLOW	ZERO COUPON	DISCOUNT FACTOR	CASH FLOW PV
1	$400,000,000	0.008	0.000669124	$2,975,868	$2500,000	$267,535	$267,470	$535,005	$3,035,005	0.064640187	0.994793858	$3,019,204
2	$399,861,630	0.01	0.000837177	$2,973,877	$2,496,656	$269,166	$334,198	$603,364	$3,100,020	0.064951452	0.989566607	$3,067,676
3	$398,190,630	0.012	0.001005543	$2,971,387	$2,492,885	$270,762	$400,800	$671,562	$3,164,447	0.065262718	0.984318886	$3,114,824
4	$397,450,069	0.014	0.00117422	$2,968,399	$2,488,688	$272,321	$467,243	$739,564	$3,228,252	0.065573983	0.979051335	$3,160,624
5	$397,768,284	0.016	0.001343212	$2,964,914	$2,484,066	$273,843	$533,493	$807,335	$3,291,401	0.065885248	0.973764592	$3,205,049
6	$396,643,169	0.018	0.001512519	$2,960,931	$2,479,020	$275,327	$599,514	$874,841	$3,353,860	0.066196513	0.968459293	$3,248,077
7	$395,768,328	0.02	0.001682143	$2,956,453	$2,473,552	$276,772	$665,273	$942,045	$3,415,597	0.066507778	0.963136077	$3,289,864
8	$394,826,284	0.022	0.001852084	$2,951,480	$2,467,664	$278,177	$730,736	$1,008,913	$3,476,577	0.066819044	0.957795576	$3,329,850
9	$393,817,371	0.024	0.002022343	$2,946,013	$2,461,359	$279,542	$795,869	$1,075,410	$3,536,769	0.067130309	0.952438426	$3,368,554
10	$392,741,961	0.026	0.002192923	$2,940,056	$2,454,637	$280,865	$860,637	$1,141,502	$3,596,140	0.067441574	0.947065258	$3,405,778
11	$391,600,458	0.028	0.002363825	$2,933,608	$2,447,503	$282,147	$925,008	$1,207,155	$3,654,658	0.067752839	0.941676703	$3,441,505
12	$390,393,304	0.03	0.002535049	$2,926,674	$2,439,958	$283,386	$988,948	$1,272,333	$3,712,291	0.068064104	0.93627339	$3,475,719
13	$389,120,970	0.032	0.002706597	$2,919,254	$2,432,006	$284,581	$1,052,423	$1,337,004	$3,769,010	0.068245995	0.930978076	$3,508,866
14	$387,783,966	0.034	0.00287847	$2,911,353	$2,423,650	$285,733	$1,115,402	$1,401,134	$3,824,784	0.068427886	0.92568647	$3,540,551
15	$386,382,831	0.036	0.003050669	$2,902,973	$2,414,893	$286,839	$1,177,851	$1,464,690	$3,879,583	0.068409777	0.920398857	$3,570,763
16	$384,918,141	0.038	0.003223197	$2,894,117	$2,405,738	$287,900	$1,239,739	$1,527,639	$3,933,378	0.068791668	0.915115519	$3,599,494
17	$383,390,502	0.04	0.003396053	$2,884,789	$2,396,191	$288,915	$1,301,033	$1,589,949	$3,986,139	0.068973559	0.909836737	$3,626,736
18	$381,800,553	0.042	0.00356924	$2,874,992	$2,386,253	$289,884	$1,361,703	$1,651,587	$4,037,840	0.06915545	0.90456279	$3,652,480
19	$380,148,966	0.044	0.003742759	$2,864,730	$2,375,931	$290,805	$1,421,717	$1,712,522	$4,088,453	0.069336575	0.899294974	$3,676,725
20	$378,436,444	0.046	0.003916611	$2,854,008	$2,365,228	$291,678	$1,481,046	$1,772,724	$4,137,952	0.069517699	0.894032637	$3,699,463
21	$376,663,720	0.048	0.004090797	$2,842,830	$2,354,148	$292,503	$1,539,658	$1,832,161	$4,186,309	0.069698824	0.88877605	$3,720,691

Figure 1: Example Amortization Schedule

In order to predict prepayments, use of an interest rate model, such as the Libor Market Model – in tandem with a commercial prepayment forecasting model – is necessary. A series of interest rate paths (e.g., 100 paths) is generated using the interest rate model, and is fed alongside loan-level data into the prepayment model. These prepayment forecasts are applied to the loan amortization schedule and expected cash flows for the MBS and servicing assets are generated and discounted.

Hedgers can tighten their expectation of price movements by utilizing breadcrumbs from TBA brokers. These come in the form of “trader durations,” which give insight to the strategy at which market makers declare their price. Trader durations, or “street durations,” are useful because every cash flow amortization model is constructed slightly differently. For example, the swaption volatility input set feeding interest rate models may differ; various practitioners may integrate different prepayment models; TBA loan collateral definitions may differ. So, the varied assumptions will naturally lead to differences in duration profiles. By tuning the cash flow amortization model to match a set of TBA durations, a hedger can “back in” to the models used by the market makers and negate any pricing errors caused by modeling assumptions.

Once the model has been tuned, durations can be updated given changes to the interest rate environment (e.g., changes in the swaption curve or the volatility surface). Updating the interest rate environment enables the model to capture non-linear behavior of bond prices. Durations should not be "set and forget" – the model should continuously adjust to account for changing market dynamics. Ignoring these dynamics will lead to poor hedge performance once durations have become stale. Trader durations should be updated in a frequent, repeatable

manner and adjusted if the market moves past predetermined thresholds to eliminate stale inputs. Every month, prepayment models should also be reviewed and tuned. What's more, volatility inputs – the primary driver of most interest rate models – should be updated daily.

As such, loan-level data plays an integral role in developing prepayment expectations. Attributes such as outstanding loan balance, a borrower's credit score or the current LTV ratio affect the economic incentive for a borrower to refinance. For example, a borrower with a remaining balance of $85,000 will exhibit less prepayment sensitivity to rate movements than a borrower with a remaining balance of $375,000. This occurs because a reduction in note rate will lead to greater total interest payment savings over the remaining life of a higher-balance loan than a lower-balance loan, including the cost of refinancing.

Loan-level prepayment dynamics are explicitly considered by investor loan pricing models. They're the genesis of the prices presented to the seller, regardless of whether one is pooling, offering loans for bulk sale, selling via the cash window or even selling via rate-sheet pricing. Similarly, loan-level prepayment dynamics drive servicing valuations and thus service release premiums. A well-structured origination hedge must take into account prepayment dynamics via specific duration profiles relevant to loan-level attributes. On its own, a TBA-level duration will not sufficiently capture the loan-level subtleties exhibited by investor pricing models. Additionally, durations for both loan asset and the servicing asset should be considered using loan-level attributes.

Hedgers will commonly form pools that are specified or limited to loans of certain cohorts, like in our $85,000 loan example, because investors will pay up for the lower prepay projections. Conversely, this can be the opposite for loans with large loan balances. For example, high-balance loans have a different duration profile than standard-balance loans of the same maturity (e.g., 30-year products) based on some of the facts mentioned previously. This difference in duration is mainly due to the different prepayment profile of high-balance loans versus standard loans; a high-balance loan is expected to be more sensitive to increased prepayment incentives (i.e., have a lower duration) than a standard loan of the same maturity, with all else equal. For this reason, hedging a loan portfolio comprised of standard- and high-balance loans with a forward contract (TBAs) for the same dollar amount can lead to over hedging.

Consider this example:

POSITION	AMOUNT($)	DURATION	DURATION RATIO	HW POSITION
Standard-Balance Loans	7,000,000	3.64	1	7,000,000.00
High-Balance Loans	3,000,000	3	0.82	2,472,527.47
TBA Sold Forward to Hedge	10,000,000	3.64	1	(10,000,000.00)
			Net Position:	(527,472.53)
			Dollar Impact of 1 bps	(5274.72)

Figure 2: Potential Duration Mismatch Impact

This simplified portfolio is made of two loan cohorts: one cohort is made up of $7 million of standard-balance loans, while the remaining $3 million is made up of high-balance loans. The duration of standard-balance loans is expected to be 3.64 on average, while the duration of high-balance loans is expected to be 3 on average. The forward instrument (TBAs) sold short to hedge the position has a duration that matches that of standard-balance loans (3.64), but that is higher than that of high-balance loans (3). This duration mismatch leads to an overall long position of $9,472,527.47 being hedged with $10 million short, for a net negative exposure of $527,427.53. This net negative exposure translates into a net position that would generate a loss of around $5,000 for each basis point of reference rate decrease. Hence, the loan portfolio manager is taking on unwanted interest rate risk that could have a material impact on profit and loss, especially in volatile markets. Therefore, understanding the concept of hedge ratio or duration ratio is critical in order to cross hedge effectively.

A hedge or duration ratio is the proportion of the duration of an instrument to that of a benchmark instrument (standard-balance loans, in this case). In the example above, the high-balance loans cohort had a hedge ratio of 0.82 (3/3.64 = 0.82). This value is lower than the duration ratio of the hedging instrument, which means that a lower amount of the hedge instrument needs to be sold short for the position to be flat. The same issue can present itself when hedging coupons that are illiquid or products such as UM10s or UM20s. Having up-to-date hedge ratios for different coupon stacks and products is important so that originators can mitigate interest rate risk and avoid unpleasant bottom-line surprises.

Hedgers have an additional risk component to consider when hedging a mortgage pipeline: the MSR. The owner of the MSR (i.e., the servicer) receives a percentage of each monthly payment made by the borrower as compensation for keeping record of payments, collecting payments, passing along principal and interest to the end investor and more. Factors such as prepayment risk and credit risk of the underlying borrower drive the level of value that an investor might pay for the MSR. For example, if a borrower refinances into a new loan, the servicing strip of their original loan becomes worthless. Other factors impact the valuation of MSRs, but projected prepayments drive the majority of MSR valuation changes. Simply stated, when interest rates go up, the value of the MSR goes up, and when interest rates go down, the value of the MSR goes down as prepayment chances rise.

The relationship between MSRs and interest rates (i.e., rates go up, MSR valuation goes up) moves inversely to how TBAs react to interest rate moves (i.e., rates go up, TBAs go down). This inverse relationship could enable hedging a portion of the mortgage pipeline with the mortgage pipeline's servicing rights. If a hedger is not including the MSR offset in their risk management, the hedger could be over hedging and incurring unnecessary hedge cost. So, how does a hedger use this relationship to impact their mortgage pipeline position?

In the chart below, a $300,000 conventional 3.5 note rate loan and servicing right is being shocked up and down 1 point in rate. In the down shocks, readers will notice that the loan will rise in value, but the servicing right will decline in value, muting gains a bit. This makes sense because as rates drop, the value of the projected mortgage bond will go up, but the odds of the loan prepaying will increase, decreasing the value of the MSR. The opposite relationship is also possible; when rates rise, the projected future mortgage bond value will decrease, but the servicing strip value will increase, offsetting some losses.

SHOCK	LOAN PRICE	LOAN DELTA	MSR PRICE	MSR DELTA	TOTAL
-100	104.82	3.57	0.89	(0.25)	3.32
-50	103.52	2.27	1.06	(0.09)	2.19
-25	102.45	1.20	1.06	(0.09)	1.11
-5	101.51	0.26	1.13	(0.01)	0.25
-2.5	101.38	0.13	1.13	(0.01)	0.12
0	101.25	-	1.14	-	-
2.5	101.12	(0.13)	1.15	0.01	(0.12)
5	100.98	(0.27)	1.16	0.02	(0.25)
25	99.82	(1.43)	1.23	0.08	(1.35)
50	98.15	(3.10)	1.31	0.17	(2.93)
100	94.13	(7.12)	1.40	0.26	(6.86)

Figure 3: Shock Scenario

The process of turning the inverse relationship between servicing and TBAs starts with accurate and granular servicing valuation. As mentioned previously, MSR valuations are heavily dependent on projected prepayment, but are also impacted by credit projections, tax and escrow assumptions, recapture and ancillary income projections, whether excess servicing is retained, the agency and remittance type associated with the servicing right, and more. The number of assumptions that impacts servicing valuations further complicates an already complex process.

Hedgers should consider licensing commercial-grade prepayment models and using cash-flow-based valuations driven by MSR broker assumption. Due to the opaque nature of the MSR market, MSR brokers play an important role as a third-party MSR valuator due to their role as active facilitators of MSR transactions. Many lenders also use the valuation provided by an MSR Broker as the value posted to financial records for the monthly MSR mark. Hedgers must ensure the pricing of an MSR is as accurate as possible because the pricing of the asset at today's interest rate will serve as the basis of the duration calculated for that asset.

To further illustrate the importance of an accurate servicing valuation, let's compare the valuation derived from a servicing grid compared to a cash-flow-based MSR model, with MSR broker assumptions, and with a commercial-grade prepayment model. In the example to the right, a 2% error in the value of the MSR, which will flow into the duration of the servicing offset, is used to hedge the position.

	GRID	CF	ERROR %
Base MSR	1.14		
UPB Adj	-0.02		
Total	**1.12**	**1.14**	**-2%**

Figure 4

The duration of the MSR should be calculated after best execution to include all information mentioned before, such as remittance type, agency, and the amount of servicing retained determined during the best execution process, in order to have the most accurate duration profile possible. For example, differences in remittance type can lead to valuation differences of ~2 basis points; not having a servicing valuation that differs in remittance type can lead to inaccurate loan sale decisions. The MSR will then be shocked throughout the same assumptions in order to calculate the duration offset.

Based on the facts detailed here, it's critical that this duration offset is calculated at the loan level to account for the idiosyncratic nature of loan data. The MSR duration would then be weighted by the pull through of the individual loans and the duration ratio to derive the actual position offset. In the example below, where we are hedging an ~$150 million pipeline, the MSR offset is ~$9 million at today's rates. If a hedger is not incorporating an MSR offset, the hedger would be over hedging by ~$9 million. If the TBA market increased ¼ of a point, the hedger would lose $22,500 due to having an extra $9 million of TBA hedges.

SHOCK	HW LOAN AMT (M)	HW TRADE AMT (M)	NET (M)	MSR OFFSET (M)	TOTAL POSITION (M)
-100	117.32	-121.00	(3.68)	(15.13)	(18.81)
-50	119.96	-120.37	(0.41)	(12.43)	(12.84)
-25	121.74	-120.31	1.43	(10.68)	(9.25)
-5	127.64	-120.49	7.15	(9.81)	(2.66)
0	129.49	-120.49	9.00	(9.34)	(0.34)
5	130.97	-120.41	10.56	(7.37)	3.19
25	134.66	-119.98	14.68	(5.64)	9.04
50	138.58	-119.74	18.84	(3.89)	14.95
100	149.89	-130.03	19.86	(2.31)	17.55

Figure 5

As you can see, mortgage origination hedgers have their work cut out for them. Hedgers need to be confident in their duration models and ensure they have timely market color and assumptions, accurate duration ratios for coupon cross hedges and specified products, and a granular cash flow MSR model powered with broker assumptions. By creating repeatable processes and technologies around them, hedgers can rest easier knowing some of these core features are automated and incorporated into their risk position. While hedgers have more than enough on their plates in today's environment, automating core risk management processes will save time and headaches, especially in volatile markets.