Modeling and Valuing Mortgage Assets

Interest rates have increased since hitting cyclical (and generational) lows over a year ago in June 2003. As interest rates increase, most banks experience a decrease in the economic value of equity, as the economic value of assets tends to be more volatile than the economic value of liabilities.

Mortgage assets tend to be among the more volatile of asset valuations, whether held as mortgages in the loan portfolio or as MBS. Mortgage assets decrease in value as interest rates increase due to:

- An increase in market (and discount) rates
- An increase in portfolio tenor (duration) as prepayments decline.

In addition, mortgage assets comprise a relatively large percentage of bank assets. For example, as of year-end 2003, MBS comprised 55% of bank investment portfolios.

In addition, as interest rates increase, premium amortization and discount accretion for purchased MBS and mortgage loans slow down. At this point in the interest rate cycle, most purchased MBS and loans are at premiums, so the deceleration of premium amortization has the impact of increasing yields. Most intermediate and advanced ALM models can project scenario-dependent income on a level yield basis, consistent with SFAS 91 requirements, thus avoiding earnings "surprises" due to accelerated premium amortization.

Given sufficiently granular mortgage data and a sufficiently robust ALM model, scenario-dependent mortgage income and values can be projected. At a minimum, ALM models require the generation of cash flows and the use of discount rates to produce estimated values. At a minimum, scenario-dependent cash flows are required to project scenario dependent interest income. This article focuses on the use of discount rates to value mortgage assets, but we also review prepayment considerations required to produce scenario-dependent cash flows, both for income and value calculations.

ALM models use four primary methods of projecting mortgage rates and valuing mortgage cash flows. In order of increasing model complexity, they are:

1. A market rate or yield
2. A nominal spread to a reference, or benchmark, Treasury rate (the "A" spread)
3. A nominal cash flow spread to an entire yield curve, typically Treasury curve (the "N" spread)
4. An option-adjusted spread (OAS) to a yield curve, typically the swap curve.

Each approach has its advantages and disadvantages, which we will consider in turn.

Regardless of the method chosen, it is important to evaluate whether calculated ALM values are (approximately) equal to market values. Benchmarking calculated ALM model values to actual and projected market values is an integral part of model review, according to OCC 2000-16 "Model Review". For MBS, scenario-dependent valuations are readily available from market sources like Bloomberg®, BondEdge®, and the like. In the following sections, we review how well the four alternatives highlighted above compare to the appropriate benchmark.

Of course, MBS values can be input into the ALM model, thus overriding calculated model values, rather than used as benchmarks. In this case, it is still important to generate scenario-dependent cash flows for liquidity and income planning purposes.

A Note on Prepayment Estimates

The majority of mortgage cash flows result from prepayments, not from scheduled amortization. Thus, the selection of reliable prepayment estimates is crucial to liquidity and valuation metrics. There are numerous sources for prepayment estimates for mortgage assets. Among the more popular are:

- Bloomberg® median estimates. These are the median of estimates produced by the mortgage research departments of several Wall Street broker/dealers.
- BondEdge® estimates. This is a widely used fixed income portfolio analytics system by many bond portfolio managers, including bankers.
- Andrew Davidson Co. (ADCO). This proprietary model is also available via Bloomberg® and can be used at the loan or MBS level inside several advanced ALM models.
- Applied Financial Technologies (AFT). This proprietary model is also available via Bloomberg® and can be used at the loan or MBS level inside several advanced ALM models.
- Intex. Most CMO and ABS deal structures provide their scheduled cash flows to this service provider. In addition, this proprietary model can be used at the loan or MBS level inside several advanced ALM models.

Those banks using independent third party sources for prepayment estimates may find that the vendors do this on a monthly basis, so it is appropriate to include this research in your well-regarded and wearisome ALM documentation.

Most of the above mortgage prepayment models are based on multi-factor regression and/or optimization models using the following factors:

- Refinance advantage, or the difference between the portfolio mortgage rate and current market rates.
- Age of the mortgage assets. Traditionally, the PSA approach is to ramp up prepayments over the first 30 months of a mortgage. More sophisticated approaches are currently used by a variety of models. This includes a factor for “burnout”. Rather than referring to the author, this refers to the tendency for some “in the money” mortgages to not refinance despite the economic advantages of doing so.
- Seasonality. Mortgages usually prepay faster during the summer months than during winter months in most parts of the country.
- Loan balance. Low loan balance loans typically prepay slower.
- FICO score. Loans with lower FICO scores typically prepay slower.
- Geographic considerations. Certain areas of the country prepay faster and/or have more prepayment volatility than others.

Regardless of the source of your prepayment estimates, it is considered a “better practice” to back-test projected prepayments versus actual prepayments. If there are continual directional variances from projections, consider scaling the forecasts to improve their accuracy. Note that

most of the prepayment models listed above periodically publish results of their forecasted prepayments versus actual prepayments.

Valuing Mortgage Assets: Using Market Rates

The simplest approach is to discount projected cash flows at a single rate for all periods. For example, if the current market rate on 30 year MBS 5.5% is 5.25%, cash flows from month 1 through month 360 are discounted at 5.25%. (See Table 1 for a comparison of rates and spreads for a 30 year 5.5% MBS as of mid-August 2004)

For many of the simpler ALM models, this is the only approach to valuation available. This simple market rate approach is consistent, as the same market, or "key" rate, is used to calculate three key ALM metrics:

- Earnings projections
- Liquidity as it is a reference point for calculating the refinance advantage and generating projected cash flows
- Sensitivity to Market Risk, in this case, economic value as it used as a discount rate for valuation purposes.

This consistency also results in improved efficiency, a consideration for time-constrained ALM managers.

A disadvantage is that the tendency for shorter assets to yield less than longer assets is not explicitly addressed. That is, while this approach is efficient, it may not always be effective. In bond market terms, this means that assets that "roll down the yield curve" may not be appropriately valued. However, 30-year MBS do not readily "roll down" the curve, somewhat mitigating this limitation. For example, a new issue 30-year MBS, with an estimated 6.4 year average life, is currently projected to have an average life in excess of 5 years three years hence, assuming rates do not change. In our proprietary benchmarking (using two advanced ALM models), new issue MBS assets were valued within 1/8 point (0.125%) across a variety of deterministic rate scenarios using this approach. Note that for heterogeneous portfolios comprised of new issue, seasoned and/or shorter assets, this approach is less accurate.

Valuing Mortgage Assets: Spread to a Reference, or Benchmark, Treasury rate

This approach is similar to the above methodology in that a single rate is used to discount cash flows for all periods. In this approach, a spread is established to a benchmark Treasury rate, like the 5- or 10-year rate. In our example, the spread to the 5-year Treasury is 1.84%. This approach has similar advantages and disadvantages to the "Market Rate" approach previously reviewed.

Occasionally, in our ALM consulting and validation assignments, we see banks using the spread to a benchmark rate, like the 5-year, with the spread to the interpolated Treasury rate (the "I" spread). In our example, with a 6.4-year average life, the spread to the interpolated 6.4-year Treasury is 1.61%, or 0.23% below the spread to the benchmark 5 year. This means that:

- Earnings projections using this lower spread are 0.23% too low
- Liquidity projections are too high, as prepayment projections using this lower spread are too low, with estimated prepayments too high
- Sensitivity to Market Risk, as measured by estimated economic value is understated, as current rate valuations are overstated by 1 and 1/8 points (or 1.127%, based on 0.23% * 4.9 modified duration).

Valuing Mortgage Assets: Cash Flow Spread
This approach uses a single spread to discount projected cash flows at a constant spread to a given yield curve, typically the Treasury curve. This means that a different rate is used for all periods. In this example, if the current market rate on 30 year MBS 5.5% is 5.25%, the cash flow spread is 1.41%. Some ALM models refer to this approach as "yield curve discounting".

Using this approach, portfolios comprised of both seasoned and new issue pools can be valued effectively. In our proprietary benchmarking (using two advanced ALM models), new issue MBS assets were valued within 1/8 point (0.125%) across a variety of rate scenarios using this approach. With modification, this methodology can be used somewhat effectively for simple "front-end" sequential structure CMO and ABS, as our benchmarks were accurate within ¼ point (0.25%) for a variety of securities across numerous rate scenarios.

Valuing Mortgage Assets: Don't Confuse Cash Flow Spread with Benchmark Spread
Frequently in our ALM consulting and validation assignments, we see banks using the spread to a benchmark rate, like the 5-year, to value mortgage assets, which is appropriate. However, some banks use this benchmark spread, coupled with a "yield curve discounting" approach to value mortgage assets. In this case, using our example:

- Sensitivity to Market Risk, as measured by estimated economic value is overstated, as current rate valuations are understated by almost 2 and 1/8 points (or 2.11%, based on {1.84%-1.41%} * 4.9 modified duration).

In institutions where mortgage-related assets comprise a significant portion of total assets, this understatement of current rate economic value can have a material impact on the calculated economic value of equity (EVE) and on the resultant Sensitivity to Market Risk. This is an unintended result of many well-intentioned ALM consultants and managers. Again, benchmarking of calculated scenario-dependent values via Bloomberg®, BondEdge®, or the OTS's price tables (available at www.ots.treas.gov) would assist in identifying this error.

Valuing Mortgage Assets: OAS to the Swap Curve
A more advanced variation of the cash flow spread approach to valuing mortgage assets is to use a benchmark OAS. While this approach is perhaps the most theoretically correct, technically rigorous, and robust (across multiple rate scenarios), it is filled with the potential for error.

Important considerations for those using the OAS approach include:

- Selection of suitable benchmark loans and bonds
- Familiarity with one- and two- factor term structure models
- Selection of appropriate rate volatilities and/or volatility surfaces
- Generation of stochastic and quasi-stochastic interest rate scenarios
- Granular prepayment estimates.

In addition, it is crucial to calibrate the benchmark OAS from the source OAS to the specific model OAS. For example, any calculated OAS is dependent on many factors, especially those listed immediately above. ALM managers using OAS benchmarks provided by Bloomberg®, BondEdge®, or broker/dealers should be aware that the underlying factors used by those

providers might vary, perhaps significantly, from those implemented inside the ALM model used at their institution.

Our approach is to select a benchmark OAS for a variety of MBS products from the same broker/dealer on a periodic basis. Then, we "reverse engineer" the OAS via Bloomberg's® OAS screen by using swaption volatilities and the same term structure model used by the ALM model. This calculated OAS is then input into the ALM model, where and model- and bond-specific OAS are re-calculated. These re-calculated OAS is usually within a few basis points to that calculated via Bloomberg®. In this manner, over time we track the calculated OAS measures in order to understand the relationship (or bias) between similar OAS methodologies with different model parameters.

Notwithstanding these considerations, in our proprietary benchmarking (using one advanced ALM model), a variety of MBS assets were valued within 1/16 point (0.06%) across an ample array of rate scenarios using this OAS approach.

Conclusion

Mortgage assets usually comprise a significant portion of bank assets, so understanding the issues related to mortgage valuation is imperative for ALM managers. A variety of methodologies can be used to value mortgage assets. Several of the more common approaches are noted in this article. Institutions using pre-defined rate scenarios usually use the market rate, benchmark spread, or cash flow spread approaches. The benchmark spread and cash flow spread approaches are usually based on the Treasury yield curve. The OAS approach is used by Wall Street and sophisticated MBS investors to value MBS. ALM models using an OAS approach are typically used by institutions that include stochastically-generated rate scenarios to measure earnings, liquidity, and market risk.

Regulatory expectations in the ALM area continue to escalate and increasingly include benchmarking and back-testing considerations. Consider periodically benchmarking calculated mortgage values and back-testing prepayment estimates to improve your ALM process and ensure regulatory compliance.

Table 1

30 year FNMA MBS 5.5% based on median PSA estimate	Market Rate	Benchmark Spread	Cash flow Spread	OAS
Rate or spread	5.25%	1.84%	1.41%	0.32%
Rate or yield curve	Rate	5 year Treasury	Treasury curve	Swap curve

Source: Bloomberg L.P., proprietary analytics

Note:
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