southwest corporate
INVESTMENT SERVICES

*Special Report*
**December 22, 2006**

**By: Amy Lin, Senior A/LM Analyst**

# STOCHASTIC VALUATION IN INTEREST RATE RISK MANAGEMENT

This is the third of a three part series on Stochastic Valuation that will present two examples of the computation and results of this analysis type. Part I defined the terms used in this type of analysis. Part II illustrated how this analysis is used. The market value of a financial instrument is the risk-adjusted expectation of the discounted value of all its future cash flows. The difficulty in valuing certain types of instruments comes from the unpredictability of the future cash flows which are caused by the fact that interest rate volatility largely impacts whether embedded options get exercised or not. Instead of valuing the instrument by using a deterministic or single interest rate path, the lattice-based approach models the behavior of interest rates and incorporates the projected future cash flows from stochastic or multiple rate scenarios into the discount valuation process.

**Part III:**
**Stochastic Valuation Computation and Results**

**Example 1:**
**Pathwise Valuation**
Mortgage-Backed Security

A mortgage-backed security or (MBS) is a type of fixed income investment with cash flows that backed by the principal and interest payments of a pool of mortgages. Payments are typically made monthly over the life of the underlying loans. Mortgage loan borrowers generally have the right to pay more than the required monthly payment at any time without penalty. The additional payments reduce the remaining loan principal and as a result, the monthly cash flows to the lender are uncertain. In general, mortgage loan prepayments accelerate when rates fall and slow when rates rise assuming all else being equal. Because of the prepayment risk (uncertainty), MBS securities usually offer higher yields than other comparable fixed income securities.

Consider a 4.94% fixed rate mortgage-backed security with a current book value of $4,837,563.40 that matures on April 25, 2034 with the following characteristics:

Coupon: 4.94%
Current Face: $4,956,590.76
Current Book: $4,837,563.40
Original Face: $ 8,625,000.00
Maturity Date: 4/25/2034

Cash flows and the discount rate drive the market value of this security.

Cash Flows – Prepayments dependent upon market interest rates affect the cash flows. If interest rates decrease, cash flows would be expected to increase and if interest rates increase, cash flows would be expected to decrease. However, the exact amount of the increase and decrease in cash flows is not known with certainty.
Discount Rates – The discount rates are the future spot rates associated with each cash flow and determined by using current interest rates, the Hull-White interest rate model and rate volatility.

To apply pathwise lattice valuation using the BancWare ALM 5.7 model, a pathwise lattice behavior is assigned along with prepayment speed projections based on the underlying collateral. The behavior specifies the applicable yield curve, interest rate model, rate volatility, sampling technique and the number of interest rate paths used in the market value calculation.
Yield curve: Treasury
Term structure of interest rates model: Hull-White
Rate volatility type: Swaption volatility
Sampling technique: Monte Carlo
Number of paths: 200

Results:
Stochastic valuation (pathwise lattice) = $4,809,104.84
Deterministic valuation (one rate path, without the lattice) = $4,860,442.86
Offering price = $4,804,423.42

As observed, the stochastic valuation is closer to the actual offering price, thus the stochastic valuation produces a more reliable result than the deterministic valuation.

**Example 2:**
**Backward Induction (or Complete Lattice)**
Callable Bond

A callable bond has a call provision embedded in its structure that allows the issuer to call the security back, when and if the desired interest rate falls. The exercise of the call results in an early redemption. Thus, all remaining interest payments cease after the call is exercised. Typically, callables offer slightly higher yields than the option-free bonds with the same maturity term to compensate the investors for the added risk (uncertainty) associated with these instruments.

Consider a 5.55% agency bond with a three year maturity that has an embedded call option exercisable in one year at par (or face value) with the following characteristics:

Face: $1,000,000.00
Coupon: 5.55%
Purchase Date: 8/31/2006
Maturity Date: 8/24/2009
Exercise Date: 8/24/2007
Strike Price: $1,000,000

Again, the market value of this security is driven by the cash flows and the discount rate.

Cash Flows – The cash flows are affected by the call provision and are dependent on the future level of interest rates. However, the specific outcome is known based on differing interest rate scenarios (i.e. the security will be called or not called).
Discount Rates – The discount rates are the future spot rates associated with each cash flow and are determined by using current interest rates, the Hull-White interest rate model, and rate volatility.

To apply backward induction valuation using the BancWare ALM 5.7 model, a behavior is assigned based on the following parameters:
Yield curve: LIBOR/Swap curve
Term structure of interest rates model: Hull-White
Rate volatility type: Swaption volatility
Number of steps per year: 12

Results:
Stochastic valuation (complete lattice) = $1,001,517.89
Deterministic valuation (one rate path, without the lattice) = $1,014,370.34
Offering price = $1,003,300.00

As observed, the stochastic valuation is closer to the actual offering price, thus the stochastic valuation produces a more reliable result than the deterministic valuation.

In summary, the advantage of assuming one interest rate path (deterministic) is its simplicity. However, interest rates can rise or fall by more than is expected. The valuation based on one rate path does not take fluctuations in interest rates into consideration. The lattice-based approach, which captures the variability or uncertainty of interest rates, is arguably a much more realistic tool to utilize in valuing financial instruments with optionality.

If you have any questions please contact:
Pat Gawenda, Manager – A/LM Modeling and Analysis, Gawendap@swcorp.org
Mark DeBree, Senior A/LM Analyst, DeBreem@swcorp.org
Amy Lin, Senior A/LM Analyst, Lina@swcorp.org