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Risk Modeling Bulletin Issue 10

Interest Rate Model

Table of Contents

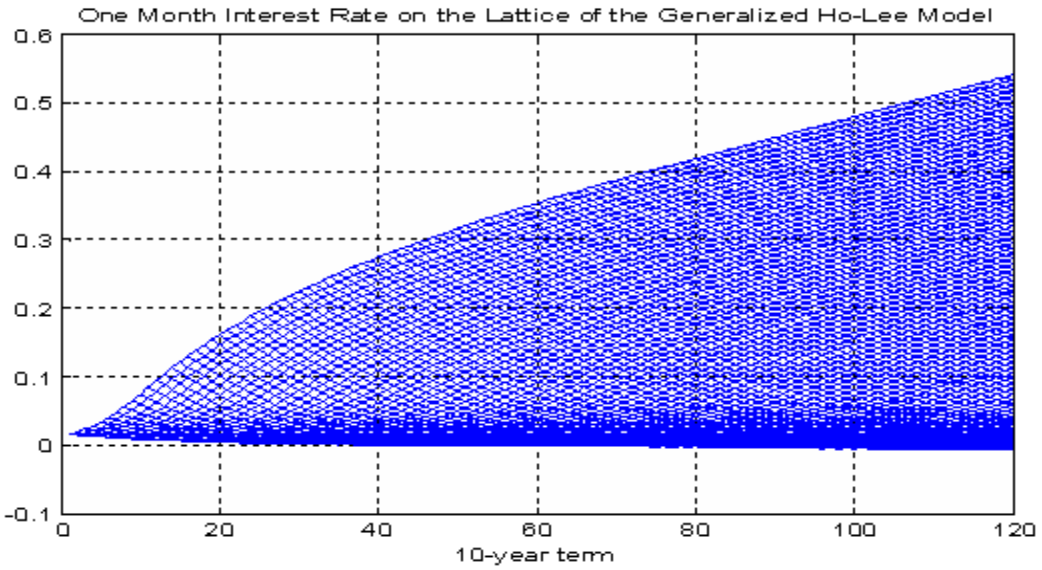
An interest rate model is useful for valuing interest rate options and fixed income instruments with embedded options. Arbitrage-free interest rate modeling has been a subject of active research for the past 20 years, yet, research continues to make significant progress. This issue describes the latest interest rate model, the Generalized Ho-Lee model in the Feature Article. Market Perspective describes the use of the model to simulate the risk exposure of a bank. Specifically, the simulation is able to determine the distribution of the value of each balance sheet item as well as the bank's NPV value over a three-month horizon.

Feature Article: The Generalized Ho-Lee Model

The Generalized Ho-Lee model (2004) extends the Ho-Lee model (1984) such that it has a number of useful attributes that, qualify it to be used effectively in a risk system: (1) it is a recombined binomial model, which can value American options most efficiently; (2) structured sampling can be established in the lattice structure to increase the computational speed; (3) the interest rate model can be calibrated to the entire volatility swaption surface with a few parameters, offering accuracy and stability; (4) the interest rate's mean reversion property is induced from the swaption prices; (5) In a straightforward manner, the model can be extended to an n-factor model or to incorporate equity risk; (6) the model can switch from a normal process to a lognormal process when interest rates fall to a certain level; (7) the model can be expressed algebraically, offering transparency in implementation. The model has been empirically tested over an extensive period, including with the use of out-of-the-money swaptions.

Figure 1 depicts the one-factor Generalized Ho-Lee model. The lattice shows that the model is recombining and that the distribution is "normal" when interest rates are high, and, lognormal when interest rates are low. The model is computationally efficient and flexible, and therefore, it offers a consistent analytical framework in a risk system, ensuring one consistent approach to valuing a broad range of financial instruments.

FIGURE 1



Reference: Ho and Lee (2002) Oxford Guide to Financial Modeling Oxford University Press pp 145-153

Market Perspective: Prospective Analysis – NPV Value Distribution

The distribution of the NPV can be simulated from the historical volatilities and the valuation models. From the simulation, we can determine the Value-at-Risk (VaR) which is defined as the potential loss at a 95% confidence level over a three-month horizon. A bank may report its VaR of the total balance sheet as well as that of all the items over the balance sheet.

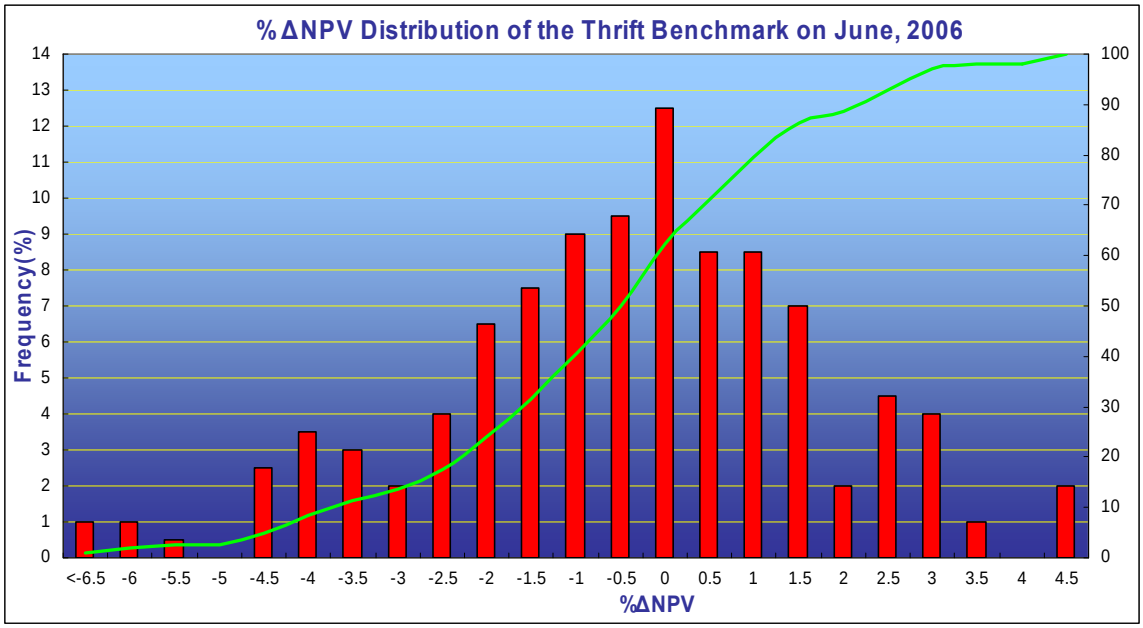
Table 1 reports the VaRs of the main items as well as the total net portfolio value of the thrift benchmark in June, 2006. As a result of diversification, the sum of the VaRs of all the items is much higher than the VaR of the net portfolio value. It seems that the VaR can be significantly attributed to the mortgage loan and securities, other assets (including all assets except for those reported in the table), deposits and borrowing.

TABLE 1: Thrift Benchmark Prospective Analysis on June, 2006 (VaR(95%) Decomposition)

Balance Sheet Item	VaR(95%)
Mortgage Loan&Securities	3.41
Nonmortgage Loan	-0.55
Cash&Deposits&Securities	-0.04
Real Assets, ETC	0.00
Mtg Loan Serviced for Others	0.01
Other Assets	6.66
Deposits	4.86
Borrowings	1.33
Other Liabilities	0.03
Self-Valued	0.00
Off-Balance-Sheet	0.01
Total Net Portfolio Value	4.68

Figure 2 depicts the distribution of the fractional change in the NPV value of the thrift benchmark on June, 2006. Since the NPV value distribution is affected by prepayment, embedded option, and withdrawal risks, comparing a bank's NPV distribution with that of a benchmark can better depicts the interest rate risk exposure.

FIGURE 2



Back Issues

1. Risk of Funding Fixed Rate Mortgages with Deposits /Yield Curve Movements /IRR Reports

2. Key Rate Duration and Non-Parallel Yield Curve Movement /Yield Curve Historical Movements /Getting Started - the Task Manager

3. Convexity and Interest Rate Volatilities /Black Volatility Surface for 06/06 /View Term Structure of Rates and Volatilities

4. Intangibles of Funding Liabilities /Mortgage OAS Values /Simulate Profits - Customized Yield/Volatility Term Structure

5. Mortgage Servicing – the IO Risk /Implied Volatilities /Speeding up The Task Function by Merging

6. Return Attribution - Retrospective Analysis /Prepayment Speed /XML Portfolio

7. Structured Advances Put Option Value /Structured Advances OAS /XML Import File

8. NPV Distribution /Interest Rate Correlations for Simulations /VaR Analysis

9. Hedging the Funding Cost Using Floors /Cap/Floor Black Volatility Curve /Do Cap/Floor/Collar Calculations

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