THC Financial Engineering
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Risk Modeling Bulletin Issue 12
Generalized Ho-Lee Two Factor Model

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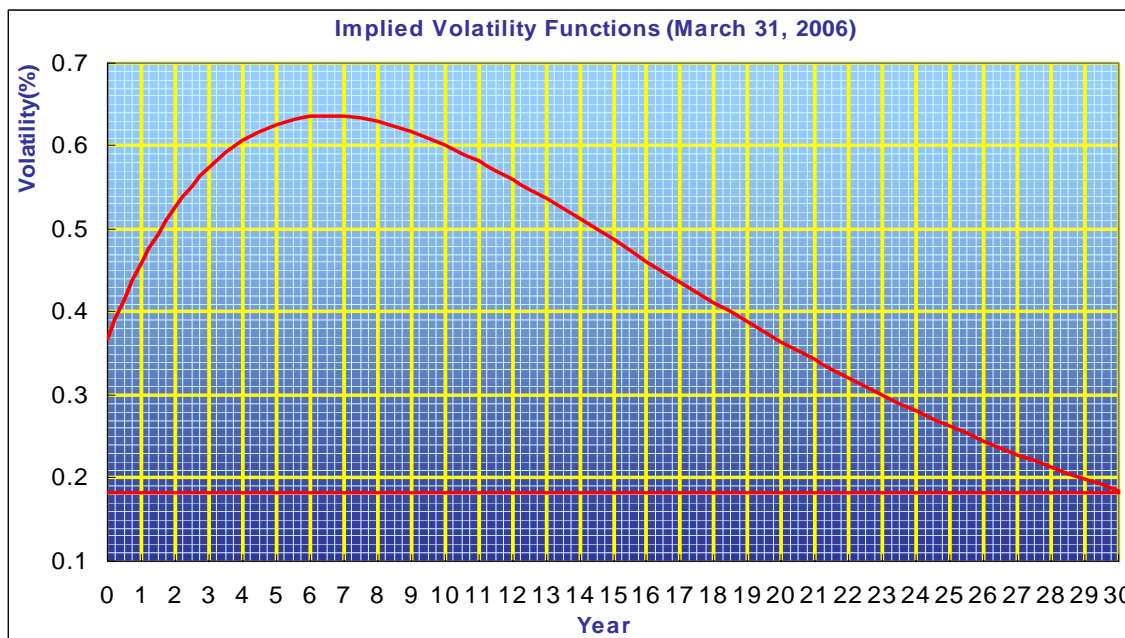| Feature Article	The Generalized Ho-Lee Two-Factor Model
Market Perspective	PO&IO Valuation Based on the Generalized Ho-Lee 1&2 Factor Models

Arbitrage-free interest rate models are core engines for valuation of financial instruments and simulation of risks. Most models in practice are called "one-factor models" because these models assume that all interest rates are perfectly correlated over any short-time period, even though this assumption is inconsistent with empirical observations. The Feature Article of this issue introduces a multi-factor model – the Generalized Ho-Lee Two-Factor Model. In Market Perspective, we compared the one-factor and two-factor model valuations of the PO (principal-only) and IO (interest-only) Strips.

Feature Article: The Generalized Ho-Lee Two-Factor Model

In the Generalized Ho-Lee one-factor model, all interest rates move with perfect correlation over each period. As a result, the yield curve cannot make a twist movement which can be observed empirically, however, as seen in the binomial lattice in bulletin #10. The Generalized Ho-Lee two-factor model is extended to deal with this problem.

The Generalized Ho-Lee two-factor model asserts that there are two yield curve movements. The two implied volatilities functions (the parallel movement and the twist movement) can be calibrated from the market prices of the swaptions. A sample of the estimated implied volatility functions is presented in figure 1, showing that on March 31, 2006, the yield curve movement was a combination of two orthogonal movements.

FIGURE 1

A lattice of the Generalized Ho-Lee two-factor model is depicted in figure 2. The two-factor model generates a two - dimensional binomial recombining lattice of interest rates.

FIGURE 2
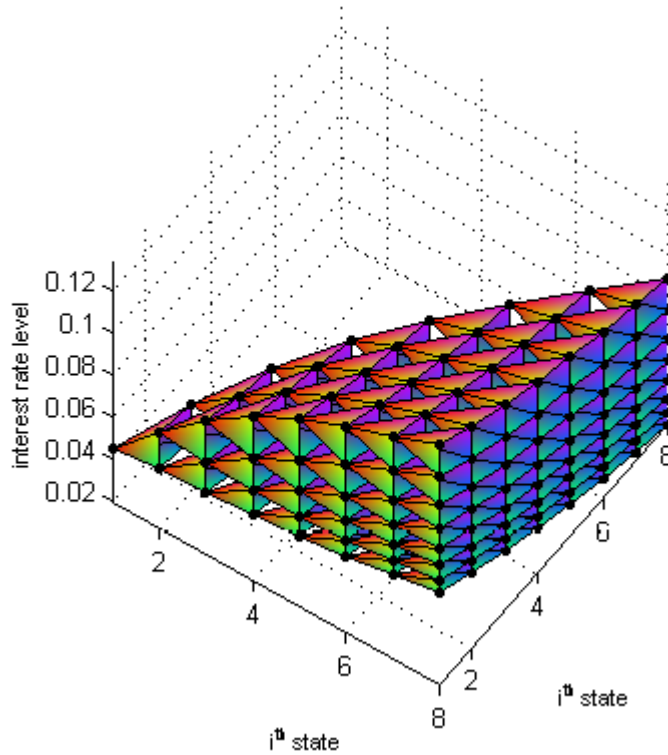
Market Perspective: PO&IO Valuation Based on Generalized Ho-Lee 1&2 Factor Models

Consider the following simulation from THC Decisions. Table 1 describes the underlying FN pass-through the PO and IO are backed on, which has minimal credit risk, and is relatively unseasoned.

TABLE 1: Description of the FN Pass-through

Effective Date	Maturity	WAC(%)		WA Credit Score	WA LTV	WA Loan Age (month)
		Original	Current			
2003-03-01	2033-04-01	5.947	5.925	731	69	43

Table 2 presents the valuation results of the PO and IO generated with the Generalized Ho-Lee one-factor and two-factor models. The results show that the difference in OAS can be as high as 36.77 basis points, and the durations can differ by 2.26 years. The two-factor model can provide more reasonable results because it exhibits the non-parallel movements of the yield curve and hence, can capture the prepayment behavior of the underlying mortgages.

TABLE 2: WALs, OASs, OADs, and OACs of the PO and IO Calculated Based on GHL 1&2 Factor Models

CMOs	Models	WAL	OAS (BP)	OAD	OAC
PO	GHL 1	5.32	188	8.27	80.40
	GHL 2	5.42	168	8.05	141.22
	Difference	-0.10	20.09	0.23	-60.82
IO	GHL 1	5.32	-268	-15.81	-71.89
	GHL 2	5.42	-231	-13.54	-344.97
	Difference	-0.10	-36.77	-2.26	273.07

Figures 3 and 4 depict the key rate durations of the PO and IO calculated with the Generalized Ho-Lee one-factor and two-factor models. The results show that for both PO and IO, the two-factor model affects the 10th year key rate duration most, confirming that the non-parallel movements of the yield curve leads to the uncorrelated 10th-year movements with the short rate, which in turn affects the estimation of prepayments of the mortgage.
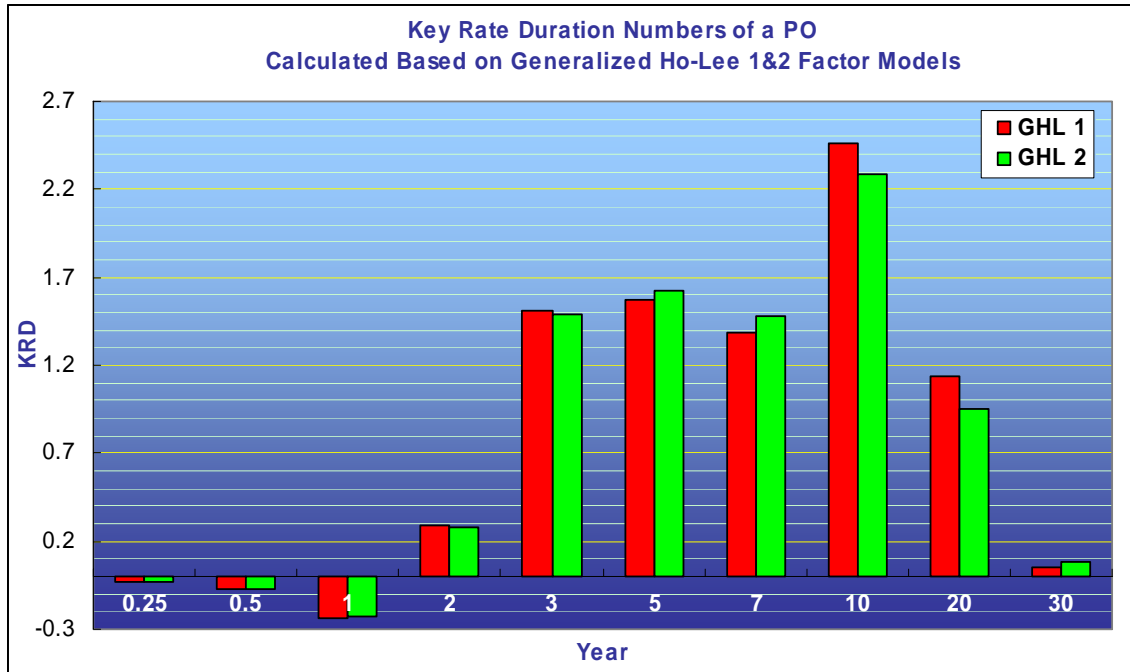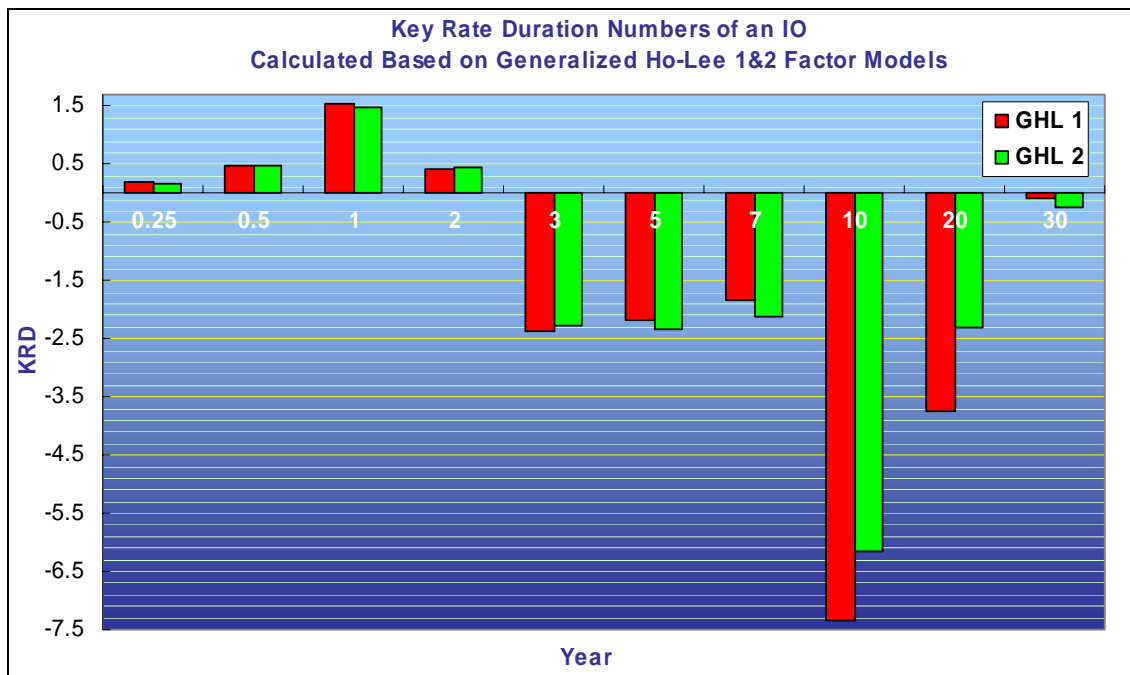
FIGURE 3

FIGURE 4

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Contact us if you have any questions, suggestions or comments

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