Pricing of Contingent Interest Rate Claims, Foundations and Application of the Hull-White Extended Vasicek Term Structure Model.

Title: Pricing of Contingent Interest Rate Claims, Foundations and Application of the Hull-White Extended Vasicek Term Structure Model

Author: Holmggaard, Anders Bæk

Abstract: This thesis is concerned with the modeling of stochastic interest rates using Gaussian mean-reverting short rate term structure models. Particularly, we consider the one-factor Vasicek model and its close descendants; the Hull-White and the Hull-White Extended Vasicek models. We provide a detailed derivation of the expressions behind the Vasicek model, and these form the basis for discussing the differences to the more elaborate versions of Vasicek’s original model. More specifically, we consider the distributional assumptions of the short rate, forward rates and bond prices, as well as their implications for the volatility structure implied by the given model. Based on this review, the Hull-White Extended Vasicek model has been chosen as platform for the subsequent analysis, due to the significantly improved flexibility offered by this model. A piecewise linear volatility function has been derived for this purpose. To enable pricing of complex and exotic interest rate derivatives, a numerical procedure is needed, whenever an analytical solution is absent. We follow the strategy of a Monte Carlo setup to implement the stochastic differential equation, describing the short rate dynamics within the Hull-White Extended Vasicek model. The model has been implemented in Excel Visual Basic and calibrated to the Black76 volatility surface of European Cap (Floors). Moreover, its numerical performance has been tested by comparing to market prices. The implementation has been applied to two illustrative applications related to pricing of different complex derivatives: a Barrier Swap and a Range Accrual note.

To justify the Monte Carlo setup, a pseudo path-dependent full-grid calibrated model, with the Hull-White Extended Vasicek model, has been tested by comparing to market prices. The implementation has been applied to two illustrative applications related to pricing of different complex derivatives: a Barrier Swap and a Range Accrual note.

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For a well full-grid calibrated model, we find that the Hull-White Extended Vasicek model reasonably captures the prices of options not too far away from ATM. Consequently, the model is less suited for instrument exposed to broader areas of the volatility surface, as becoming expensive in time and generality.

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