Pricing Swaptions Within an Affine Framework

Pierre Collin-Dufresne, Robert S. Goldstein

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(/content/iijderiv/10/1)

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Abstract

Valuation theory for the most widely used interest rate derivatives, such as swaps, bond options, and caps and floors, is highly developed. But adapting the theory for use in the field is not trivial. Several stochastic factors at least are needed to approximate the empirical term structure, with which the model must be consistent. Affine models offer a general multifactor structure with good mathematical properties. However, if the factors follow standard probability processes, Gaussian or Cox-Ingersoll-Ross square root diffusions, for instance, the probability distributions for future bond prices, swap rates, and so on, will not have common forms. Valuing interest rate derivatives typically requires burdensome numerical solution of multivariate integrals, which limits the number of stochastic factors that can be considered, as well as the accuracy with which any given solution can be computed. Collin-Dufresne and Goldstein present a new technique for pricing interest rate derivatives in a much more efficient manner. Within an affine framework, the probability density for a bond price will not normally exist in closed-form, but all of its moments will. An Edgeworth expansion using a

small number of these analytic moment expressions yields an approximation to the density function that is both very accurate and extremely fast to compute. Pricing accuracy and computation speed are increased by many orders of magnitude for a single option, and little additional computation is needed to price multiple contracts with differing strikes.

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