Exact solutions for bond and option prices with systematic jump risk

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Abstract

A variety of realistic economic considerations make jump-diffusion models of interest rate dynamics an appealing modeling choice to price interest-rate contingent claims. However, exact closed-form solutions for bond prices when interest rates follow a mixed jump-diffusion process have proved very hard to derive. This paper puts forward two new models of interest-rate dynamics that combine infrequent, discrete changes in the interest-rate level, modeled as a jump process, with short-lived, mean reverting shocks, modeled as a diffusion process. The two models differ in the way jumps affect the central tendency of interest rates; in one case shocks are temporary, in the other shocks are permanent. We derive exact closed-form solutions for the price of a discount bond and computationally tractable schemes to price bond options.

References

Ahn, Chang Mo, and Howard E. Thompson. (1988). "Jump-Diffusion Processes and the Term Structure of Interest Rates." *Journal of Finance* 43, 155–174.

Google Scholar

Balduzzi, Pierluigi, Giuseppe Bertola, and Silverio Foresi. (1993). “A Model of Target Changes and the Term Structure of Interest Rates.” NBER Working Paper No. 4347.

Balduzzi, Pierluigi, Sanjiv Das, and Silverio Foresi. (1995). “The Central Tendency: A Second Factor in Bond Yields.” Unpublished manuscript, New York University.

Bates, David. S. (1993). “Jumps and Stochastic Volatility: Exchange Rate Processes Implicit in PHLX Deutschemark Options.” NBER Working Paper No. 4596, forthcoming*Review of Financial Studies*.

Constantinides, George. (1992). “A Theory of the Nominal Term Structure of Interest Rates.”*Review of Financial Studies* 5(4), 531–552.

Google Scholar

Cox, John, Johnathan E. Ingersoll, and Stephen A. Ross. (1985a). “An Intertemporal General Equilibrium Model of Asset Prices.”*Econometrica* 53, 363–384.

Google Scholar

Cox, John, Johnathan E. Ingersoll, and Stephen A. Ross. (1985b). “A Theory of the Term Structure of Interest Rates.”*Econometrica* 53, 385–406.

Google Scholar

Duffie, Darrell. (1992).*Dynamic Asset Pricing Theory*. Princeton, NJ: Princeton University Press.

Google Scholar

Duffie, Darrell, and R. Kan. (1993). “A Yield-Factor Model of Interest Rates.”

Unpublished manuscript, Stanford University.

Heston, Steven L. (1993). “A Closed-Form Solution for Options with Stochastic Volatility with Applications to Bond and Currency Options.”*Review of Financial Studies* 6(2), 327–343.

Google Scholar

Jamshidian, Farshid. (1989). “An Exact Bond Option Formula.”*Journal of Finance* 44, 205–209.

Google Scholar

Karlin, Samuel, and Howard Taylor. (1981). “A Second Course in Stochastic Processes.” London: Academic Press.

Google Scholar

Kushner, Harold. (1967). “Stochastic Stability and Control.” New York:Academic Press.

Google Scholar

Merton, Robert C. (1976). “Option Pricing When the Underlying Stock Returns Are Discontinuous.”*Journal of Financial Economics*, 125–144.

Naik, Vasant, and Moon Lee. (1994). “The Yield Curve and Bond Option Prices with Discrete Shifts in Economic Regimes.” Working Paper, University of British Columbia.

Sun, T. S. (1992). “Real and Nominal Interest Rates: A Discrete-Time Model and Its Continuous-Time Limit.”*Review of Financial Studies* 5(4), 581–611.

Google Scholar

Turnbull, Stuart and Frank Milne. (1991). “A Simplified Approach to Interest Rate Option Pricing.”*Review of Financial Studies* 4(1), 87–120.

Google Scholar

Vasicek, Oldrich. (1977). “An Equilibrium Characterization of the Term Structure.”*Journal of Financial Economics* 5, 177–188.

Google Scholar

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