Journal of Statistical Physics, Vol. 120, Nos. 1/2, July 2005 (© 2005)
DOI: 10.1007/s10955-005-5473-z

Book Review: *Quantum Finance, Path Integrals and Hamiltonians for Options and Interest Rates*

Quantum Finance, Path Integrals and Hamiltonians for Options and Interest Rates. B. E. Baaquie, Cambridge University Press, Cambridge, 2004.

This book discusses several concepts that relate to quantitative finance in terminology used in quantum mechanics and quantum field theory. It provides an alternative to established methods based on stochastic calculus and stochastic differential equations.

Two principal applications are discussed: option pricing and the theory of interest rates. In the first of these, the Black-Scholes equation for the option price with constant volatility is reformulated in terms of a non-Hermitian Hamiltonian. Within this framework, methods commonly used in quantum mechanics can be applied. In this way Baaquie derives the pricing kernel for both constand and stochastic volatility. He is then able to cast the martingale property in terms of Hamiltonian formalism as well as defining a potential compatible with the martingale property, thereby allowing him to model options relatively straightforwardly. In the following chapter the author revisits option pricing, there deriving a Lagrangian based on Feynman path integrals. This allows him to develop formalism for the theory of interest rates.

The final portion of the book is entirely devoted to the theory of interest rates. Baaquie's idea is that the complexity of forward rates is such that the random yield curves require infinitely many degrees of freedom. This establishes a relation to quantum field theory. Moreover, the somewhat subtle and hidden correlations between different maturities which are described in terms commonly used in the theory of quantum fields. I personally find the strategy of formulating a quantum field theory of interest rates a potentially useful one in possibly providing a step forward in understanding the evolution of forward rates and associated correlations. Unfortunately, the level of the book is such that readers other than those trained in theoretical physics may not be able to meet the technical challenge of reading it. The author has tried to overcome this challenge

by providing introductory material on finance for readers in the physics community as well as introductory material for those in the mathematical finance community who are presumably unfamiliar with quantum mechanics, path integrals, and quantum field theory. In any case the book is valuable in trying to marry two very demanding fields.

Jaume Masoliver
Departament de Fisica Fonamental
Universitat de Barcelona
Diagonal 647
08028 Barcelona, Spain
E-mail: jaume.masoliver@ub.edu