Preface

Since the publication of our coedited monograph *Hidden Markov Models (HMM) in Finance* by Springer in 2007, there has been substantial research in many areas of finance which employ HMM. It is the objective of this edited volume to present some updates on the current state of the field. The book brings together several articles which explore the most recent developments of HMMs and their applications to financial modelling. The main themes in this collection, combining new theoretical advances and applications, are improvements of the EM algorithm for HMMs, interest rates, foreign exchange, insurance, option pricing, trading and parameter estimation within some extended HMM frameworks.

The lead paper 'Robustification of an Online EM Algorithm for Modelling Asset Prices Within an HMM', by C. Erlwein-Sayer and P. Ruckdeschel, considers the robustification of the EM algorithm in conjunction with Elliott's pioneering work (1994) on exact adaptive filters for Markov chains observed in Gaussian noise. This innovation aims to tackle the presence of outliers in financial data and preserves confidence in the results of the HMM estimation procedure.

The succeeding three articles showcase various approaches in modelling interest rates under HMM-driven regime-switching frameworks. In their paper 'Stochastic Volatility or Stochastic Central Tendency: evidence from a Hidden Markov Model of the Short-Term Interest Rate', C.A. Wilson and R.J. Elliott show the importance of stochastic volatility over stochastic central tendency in capturing the evolution of interest rates. It features an iterative procedure in determining the likelihood function; numerical maximisation was used to find maximum likelihood estimates. Wu and Zeng put forward a model with an analytically simple representation of the Markov regime shifts but which is capable of handling the stylised features of the yield curve in their paper 'An Econometric Model of the Term Structure of Interest Rates Under Regime-Switching Risk'. The efficient method of moments was utilised in their empirical examination of US data within a two-factor version of their proposed model. Continuing the theme of interest-rate modelling, L. Steinrücke, R. Zagst and A. Swishchuk extended the LIBOR market model to incorporate sudden market shocks, structural breaks and changes in economic climate. Their paper 'The LIBOR market

model: a Markov-switching jump diffusion extension' includes model calibration to real data illustrating potential usability for practitioners.

'Exchange Rates and Net Portfolio Flows: a Markov-Switching Approach', by F. Menla, F. Spagnolo and N. Spagnolo, is a paper which describes the usefulness of Markov-switching tools to investigate the finer structure of the foreign exchange rate market. In particular, it probes the effects of bond and equity portfolio flows to exchange rate dynamics. Covering major currencies against the US dollar, it is a far-reaching empirical study that explores the relationship between portfolio flows and fluctuations in the exchange rate changes.

In recent years, there has been a proliferation of finsurance business due to the significant growth in the creation of derivatives that blend the characteristics of financial and insurance products. These instruments require new methods to deal with their complexity. P. Azimzadeh, P.A. Forsyth and K.R. Vetzal examine the valuation and hedging of guaranteed lifelong withdrawal and death benefits contracts in their paper 'Hedging Costs for Variable Annuities Under Regime Switching'. A general approach is constructed which enables utility-based pricing and other factors to be taken into account and yields a system of partial differential equations (PDEs). The system is solved using an implicit method for a large class of utility functions that govern the withdrawal behaviour of the policyholders.

D. Nguyen, G. Yin and Q. Zhang analyse an optimal trading strategy assuming a bull-bear regime-switching market. Their paper 'A Stochastic Approximation Approach for Trend-Following Trading' delves into a buy–sell strategy that maximises expected return. The optimality of such a strategy is achieved by determining threshold levels through a stochastic approximation algorithm. This circumvents the need to solve Hamilton–Jacobi–Bellman-type equations.

Some contributions to the ubiquitous and popular problem of option pricing under an HMM setting are contained in two papers included in this monograph. TK Siu's article 'A Hidden Markov-Modulated Jump Diffusion Model for European Option Pricing' is concerned with a two-step valuation procedure. It consists of using filtering methods and the Esscher transform to derive an integro-partial differential equation satisfied by the price of a European option. The paper 'An Exact Formula for Pricing American Exchange Options with Regime Switching' by L. Chan provides the valuation of exchange options of American style when the parameters of the underlying variable are governed by an HMM. A homotopy analysis-based method is utilised to calculate the value of an American option in this framework.

The last two papers highlight the estimation of model parameters under HMM frameworks with enhanced flexibility of modelling other features of observed market data. The emphasis is on their potential implementation in financial derivative valuation, risk management and asset allocation. X. Xi and R. Mamon's paper 'Parameter Estimation in a Weak Hidden Markov Model with Independent Drift and Volatility' gives the estimation procedure for the drift and volatility components in a model where they are independently influenced by two separate higher-order HMMs with different state spaces. Such a procedure enables the incorporation of memory in historical data in addition to occasional structural changes. Finally, another way to augment the capability of the HMM setting is to build an

estimation scheme assuming that the signal model has a non-normal perturbation. This is discussed in the paper 'Parameter Estimation in a Regime-Switching Model with Non-normal Noise' by L. Jalen and R. Mamon. For this setting, the dynamic estimation of transition probabilities can still rely on recursively filtered estimates of quantities that are functions of the Markov chain. Concentrating on noise having a Student's t-distribution, it is demonstrated that the estimation of the other remaining parameters amounts to solving a system of nonlinear equations which can be readily accomplished by using modern computing software.

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