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Editorial

# Econometric analysis of financial derivatives: An overview☆

Chia-Lin Chang[a,b], Michael McAleer[c,d,e,f,*]

[a] Department of Applied Economics, National Chung Hsing University, Taiwan
[b] Department of Finance, National Chung Hsing University, Taiwan
[c] Department of Quantitative Finance, National Tsing Hua University, Taiwan
[d] Econometric Institute, Erasmus School of Economics, Erasmus University Rotterdam, The Netherlands
[e] Tinbergen Institute, The Netherlands
[f] Department of Quantitative Economics, Complutense University of Madrid, Spain

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ABSTRACT

One of the fastest growing areas in empirical finance, and also one of the least rigorously analyzed, especially from a financial econometrics perspective, is the econometric analysis of financial derivatives, which are typically complicated and difficult to analyze. The purpose of this special issue of the journal on "Econometric Analysis of Financial Derivatives" is to highlight several areas of research by leading academics in which novel econometric, financial econometric, mathematical finance and empirical finance methods have contributed significantly to the econometric analysis of financial derivatives, including market-based estimation of stochastic volatility models, the fine structure of equity-index option dynamics, leverage and feedback effects in multifactor Wishart stochastic volatility for option pricing, option pricing with non-Gaussian scaling and infinite-state switching volatility, **s**tock return and cash flow predictability: the role of volatility risk, the long and the short of the risk-return trade-off, what's beneath the surface? option pricing with multifrequency latent states, bootstrap score tests for fractional integration in heteroskedastic ARFIMA models, with an application to price dynamics in commodity spot and futures markets, a stochastic dominance approach to financial risk management strategies, empirical evidence on the importance of aggregation, asymmetry, and jumps for volatility prediction, non-linear dynamic model of the variance risk premium, pricing with finite dimensional dependence, quanto option pricing in the presence of fat tails and asymmetric dependence, smile from the past: a general option pricing framework with multiple volatility and leverage components, COMFORT: A common market factor non-Gaussian returns model, divided governments and futures prices, and model-based pricing for financial derivatives.



## 1. Introduction

According to the International Monetary Fund, "Financial derivatives are financial instruments that are linked to a specific financial instrument or indicator or commodity, and through which specific financial risks can be traded in financial markets in their own right.… Financial derivatives are used for a number of purposes including risk management, hedging, arbitrage between markets, and speculation". Derivatives are associated with numerous types of financial contracts, including the widely-used and analyzed futures, options and forward prices, credit default swaps, and mortgage backed securities. Together with stocks and bonds, derivatives comprise the third main category of financial instruments, and are typically exchange traded or over-the-counter.

One of the fastest growing areas in empirical finance, and also one of the least rigorously analyzed, especially from a financial econometrics perspective, is the econometric analysis of financial derivatives. Risk management is crucial for optimal portfolio management. While some of the key issues underlying risk and portfolio management are reasonably well understood, many of

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* Corresponding author at: Department of Quantitative Finance, National Tsing Hua University, Taiwan.
*E-mail address:* michael.mcaleer@gmail.com (M. McAleer).

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the technical issues underlying the creation and movements in financial derivatives are less well understood.

Derivatives can be very complex, as evidenced by the massive losses incurred by J.P. Morgan in 2012, which seem to have combined various measures of incompetence, ignorance, failure to comply with financial regulations, and corruption. Senator Carl Levin, Chairman of the Senate Subcommittee on Investigations, summarized the pervasive cynicism and concern when he stated: "Derivative values that cannot be trusted are a serious risk to our financial system" (14 March 2013).

The purpose of the special issue is to bring together the leading specialists in financial econometrics, statistics and mathematics to provide a rigorous theoretical approach to "Econometric Analysis of Financial Derivatives". Mathematical finance will be combined with rigorous theoretical and empirical econometric and statistical analyses of ultra high and high frequency data, using continuous time and discrete time models to analyze realized, stochastic and conditional volatility, as well as higher moments, for univariate and multivariate processes.

Financial derivatives are typically complicated and difficult to analyze. The special issue presents an extensive range of papers by the leading scholars in the field on "Econometric Analysis of Financial Derivatives". The purpose of the special issue is to highlight a number of areas of research in which novel econometric, financial econometric and empirical finance methods have contributed significantly to the econometric analysis of financial derivatives, specifically market-based estimation of stochastic volatility models (Aït-Sahalia et al., in this issue), the fine structure of equity-index option dynamics (Andersen et al., in this issue), leverage and feedback effects in multifactor Wishart stochastic volatility for option pricing (Asai and McAleer, in this issue), option pricing with non-Gaussian scaling and infinite-state switching volatility (Baldovin et al., in this issue), **s**tock return and cash flow predictability: the role of volatility risk (Bollerslev et al., in this issue), the long and the short of the risk-return trade-off (Bonomo et al., in this issue), What's beneath the surface? option pricing with multifrequency latent states (Calvet et al., in this issue), bootstrap score tests for fractional integration in heteroskedastic ARFIMA models, with an application to price dynamics in commodity spot and futures markets (Cavaliere et al., in this issue), a stochastic dominance approach to financial risk management strategies (Chang et al., in this issue), empirical evidence on the importance of aggregation, asymmetry, and jumps for volatility prediction (Duong and Swanson, in this issue), non-linear dynamic model of the variance risk premium (Eraker and Wang, in this issue), pricing with finite dimensional dependence (Gourieroux and Monfort, in this issue), quanto option pricing in the presence of fat tails and asymmetric dependence (Kim et al., in this issue), smile from the past: a general option pricing framework with multiple volatility and leverage components (Majewski et al., in this issue), COMFORT: A common market factor non-Gaussian returns model (Paolella and Polak, in this issue), divided governments and futures prices (Sojli and Tham, in this issue), and model-based pricing for financial derivatives (Zhu and Ling, in this issue).

The interesting, timely and novel contributions to this special issue should highlight and encourage innovative research in a variety of challenging areas associated with the topical and rapidly expanding areas of financial derivatives. It is exciting that the leading international leaders in the field have agreed to contribute to an innovative special issue on "Econometric Analysis of Financial Derivatives".

The plan of the remainder of the paper is as follows. An overview of the 17 papers is presented in Section 2, and some final remarks are given in Section 3.

## 2. Overview

The first paper is "Pricing with finite dimensional dependence" by Christian Gourieroux (CREST, France, University of Toronto, Canada) and Alain Monfort (CREST, France, Banque de France, France). The authors consider derivative pricing in factor models, where the factor is Markov with Finite Dimensional Dependence (FDD). The FDD condition allows for explicit formulae for derivative prices and their term structures. In this respect, the FDD models are serious competitors for models with affine dynamic factors, especially as they are numerically less demanding. The approach is illustrated by a comparison of the prices of realized and integrated volatility swaps. The authors show that the usual practice of replacing a payoff written on the realized volatility by a payoff written on the integrated volatility can imply pricing errors which are not negligible when the volatility of the volatility is large.

In the second paper, "Market-based estimation of stochastic volatility models", by Yacine Aït-Sahalia (Department of Economics, Princeton University and NBER, USA), Dante Amengual (Centro de Estudios Monetarios y Financieros (CEMFI), Madrid, Spain), and Elena Manresa (Centro de Estudios Monetarios y Financieros (CEMFI), Madrid, Spain), the authors propose a method for estimating stochastic volatility models by adapting the HJM approach to the case of volatility derivatives. They characterize restrictions that observed variance swap dynamics have to satisfy to prevent arbitrage opportunities. When the drift-of-variance swap rates are affine under the pricing measure, they obtain closed-form expressions for the restrictions and formulae for forward variance curves. Using data on the S&P500 index and variance swap rates on different times to maturities, the authors find that linear mean-reverting one factor models provide an inaccurate representation of the dynamics of the variance swap rates, while two-factor models significantly outperform one factor models, both in and out of sample.

The third paper by Manabu Asai (Faculty of Economics, Soka University, Tokyo, Japan) and Michael McAleer (National Tsing Hua University, Taiwan) is on "Leverage and feedback effects on multifactor Wishart stochastic volatility for option pricing". The authors propose a general asymmetric multifactor Wishart stochastic volatility (AMWSV) diffusion process which accommodates leverage, feedback effects and multifactor for the covariance process. The paper provides the closed-form solution for the conditional and unconditional Laplace transform of the AMWSV models. In addition, the paper suggests estimating the AMWSV model by the generalized method of moments using information not only from stock prices but also from the realized volatilities and co-volatilities. The empirical results for the bivariate data of the NASDAQ 100 and S&P 500 indices show that the general AMWSV model is preferred from among several nested models.

"Model-based pricing for financial derivatives", the fourth paper, is by Ke Zhu (Chinese Academy of Sciences, China) and Shiqing Ling (Department of Mathematics, Hong Kong University of Science and Technology, China). The authors consider a stock price process and a bond price process with a constant continuously compounded risk-free interest rate, where both are defined on an appropriate probability space. The returns on the stock price can generally be decomposed into a conditional mean component and a noise component with volatility, but the discounted stock price is not a martingale under the probability space. In a general framework, the authors obtain a risk-neutralized measure under which the discounted stock price is a martingale. Using this measure, the authors show how to derive the risk neutralized price for the derivatives. Special examples of pricing models based on symmetric and asymmetric conditional volatility are given. A simulation

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