Option pricing with non-Gaussian scaling and infinite-state switching volatility

Fulvio Baldovin, Massimiliano Caporin, Michele Caraglio, Attilio L. Stella, Marco Zamparo

PII: S0304-4076(15)00058-5
DOI: http://dx.doi.org/10.1016/j.jeconom.2015.02.033
Reference: ECONOM 4055

To appear in: *Journal of Econometrics*

Please cite this article as: Baldovin, F., Caporin, M., Caraglio, M., Stella, A.L., Zamparo, M., Option pricing with non-Gaussian scaling and infinite-state switching volatility. *Journal of Econometrics* (2015), http://dx.doi.org/10.1016/j.jeconom.2015.02.033

Option pricing with non-Gaussian scaling and infinite-state switching volatility

Fulvio Baldovin* Massimiliano Caporin† Michele Caraglio*
Attilio L. Stella* Marco Zamparo‡

Abstract: Volatility clustering, long-range dependence, and non-Gaussian scaling are stylized facts of financial assets dynamics. They are ignored in the Black & Scholes framework, but have a relevant impact on the pricing of options written on financial assets. Using a recent model for market dynamics which adequately captures the above stylized facts, we derive closed form equations for option pricing, obtaining the Black & Scholes as a special case. By applying our pricing equations to a major equity index option dataset, we show that inclusion of stylized features in financial modeling moves derivative prices about 30% closer to the market values without the need of calibrating models parameters on available derivative prices.
Keywords: option pricing; anomalous scaling; Markov switching; GARCH
JEL Classifications: C58; G13; C22; C51; C52; C53

1 Introduction

Dynamical properties and stylized facts of financial time series have raised considerable interest in both theoretical and applied econometrics. Within these fields, one topic widely discussed is related to the memory properties observed over return sequences, in particular regarding their absolute value (volatility). A variety of techniques have been developed to include realistic volatility dynamic features into a continuous time model, thus improving the geometric Brownian motion assumption underlying the classic Black-Scholes (BS) model. We mention, among many others, the stochastic volatility, see, e.g., Fouque et al. (2000) and therein cited references, the and GARCH-based approach of Heston (1993), and Heston and Nandi (2000). In what follows, volatility memory properties, and in particular the long-memory behaviour, are taken into account on the basis of the "scaling

*University of Padova, Department of Physics and Astronomy
†University of Padova, Department of Economics and Management, corresponding author: massimiliano.caporin@unipd.it
‡Politecnico di Torino, Department of Applied Science and Technology, and Human Genetics Foundation Torino