位移與混合型離散過程對波動度模型之解析與實證

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摘要

Brigo 與 Mercurio 提出了三種新的資產價格過程，分別是位移 CEV 過程、位移對數常態過程與混合對數常態過程。在這三種過程中，資產價格的波動度不再是一個固定的常數，而是時間與資產價格的明確函數。而由這三種過程所推導出來的歐式選擇權評價公式，將會導致隱含波動度曲線呈現傾斜曲線或是微笑曲線，且提供了參數讓我們能夠配適市場的波動度結構。本文利用台指買權來實證 Brigo 與 Mercurio 所提出的三種歐式選擇權評價公式，我們發現校準結果以混合對數常態過程優於位移 CEV 過程，而位移 CEV 過程則稍優於位移對數常態過程。因此，在實務校準時，我們建議以混合對數常態過程爲台指買權的評價模型，以達到較佳的校準結果。

關鍵字：資產價格的動態過程，風險中立機率測度，選擇權評價公式，波動度傾斜，波動度微笑，非線性規劃，參數校準。

Displaced and Mixture Diffusions for Analytically-Tractable Smile Models

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ABSTRACT

Brigo and Mercurio proposed three types of asset-price dynamics which are shifted-CEV process, shifted-lognormal process and mixture-of-lognormals process respectively. In these three processes, the volatility of the asset price is no more a constant but a deterministic function of time and asset price. The European option pricing formulas derived from these three processes lead respectively to skew and smile in the term structure of implied volatilities. Also, the pricing formula provides several parameters for fitting the market volatility term structure. The thesis applies Taiwan's call option to verifying these three pricing formulas proposed by Brigo and Mercurio. We find that the calibration result of mixture-of-lognormals process is better than the result of shifted-CEV process and the calibration result of shifted-CEV process is a little better than the result of shifted-lognormal process. Therefore, we recommend applying the pricing formula derived from mixture-of-lognormals process to getting a better calibration.

Keywords：asset-price dynamics, risk-neutral density, option pricing formula, volatility skew, volatility smile, nonlinear programming, calibration of parameters.