Nonlinear Leverage Effects in Asset Returns: Evidence from American and Japanese Stock Markets

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Abstract

We develop a new structure to model the correlation between an asset's return and its volatility in stochastic volatility models. This correlation is often referred to as the leverage effect in the literature and is considered to be negative so that a negative shock in a stock price increases its volatility. While this relation is intuitive and is followed by a plethora of economic reasoning, empirical evidence suggests that most individual stocks have zero correlation and thus no leverage effect. Therein lies the leverage effect puzzle. In this paper, we develop a nonlinear generalization of the leverage effect, or rather the leverage function, within a stochastic volatility setting. We adopt Hermite polynomials as the orthogonal basis of the leverage function and estimate the parameters via particle learning, a sequential Monte Carlo method when the sufficient statistics of the parameters are known. However, for the model of interest and in most complex nonlineiar/non-Gaussian models, the sufficient statistics are unknown. For this reason, we develop a novel and flexible particle learning algorithm using auxiliary variables. Examining 682 stocks that composite the S&P500, NASDAQ, and Nikkei 225, we find four thirds of the stocks to exhibit complex volatility structures. We further the analysis by examining whether there are clear traits in which stock have more complex volatility structures. We find evidence that country and few sectors to have an effect on the volatility structure.

Keywords: Leverage Effect, Particle Learning, Stochastic Volatility Model.

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