Available online at www.sciencedirect.com
ScienceDirect
Journal of Banking & Finance 31 (2007) 2751–2769
Journal of BANKING & FINANCE Applied Section
www.elsevier.com/locate/jbf

# Volatility clustering, leverage effects, and jump dynamics in the US and emerging Asian equity markets

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Received 11 March 2005; accepted 22 December 2006
Available online 29 April 2007

## Abstract

This paper proposes asymmetric GARCH-Jump models that synthesize autoregressive jump intensities and volatility feedback in the jump component. Our results indicate that these models provide a better fit for the dynamics of the equity returns in the US and emerging Asian markets, irrespective whether the volatility feedback is generated through a common GARCH multiplier or a separate measure of volatility in the jump intensity function. We also find that they can capture several distinguishing features of the return dynamics in emerging markets, such as, more volatility persistence, less leverage effects, fatter tails, and greater contribution and variability of the jump component.


*JEL classification:* C22; F31; G15

*Keywords:* Volatility feedback; Time-varying jump intensity; Volatility clustering; Leverage effect; Leptokurtosis

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0378-4266/$ - see front matter 
doi:10.1016/j.jbankfin.2006.12.012

## 1. Introduction

Mixed GARCH-Jump modeling has emerged as a powerful tool to describe the dynamics of asset returns in discrete-time. Recent work in this area by, for example, Duan et al. (2005, 2006) and Maheu and McCurdy (2004) allows for time-variation in the jump component of the mixed GARCH-Jump model. In particular, Duan et al. develop a constant intensity NGARCH-Jump model that allows for time-variation through a common GARCH multiplier in the "diffusion" and jump component.[1] In the limit, their discrete-time model can converge to continuous-time jump-diffusion processes with jumps in the stochastic volatility. They find that the NGARCH-Jump model provides a better fit for the time-series of S&P 500 index returns relative to the normal NGARCH specification. Maheu and McCurdy develop a mixed GARCH-Jump model that admits separate time-variation and clustering in the jump intensity, but does not accommodate for volatility feedback in the jump component. When applied to individual stocks and indices in the US, their model outperforms the GARCH-Jump model with constant intensity and i.i.d. jump component. These findings give rise to the question which jump structure best fits the asset return dynamics under an asymmetric GARCH specification. Is it volatility feedback in the jump component, autoregressive jump intensity, or a combination of both? Should volatility feedback in the jump component be generated through a common GARCH multiplier or a separate measure of volatility in the jump intensity function?

To answer these questions, we propose asymmetric GARCH-Jump models that synthesize autoregressive jump intensities and volatility feedback in the jump component. We offer two extensions of the existing GARCH-Jump models. First, we extend the constant intensity asymmetric GARCH-Jump model in Duan et al. (2005, 2006) by accommodating for time-varying, autoregressive jump intensity. This extension allows for two sources of time-variation in the jump component, namely, the common GARCH multiplier and the separate autoregressive arrival rate of jumps. Each factor affects the variation in jumps in a different way. The common GARCH multiplier induces time-variations in the jump component that are synchronous with the diffusion component, making these two components inseparable. In contrast, the autoregressive intensity allows the probability of jumps to change over time and can generate variations in the jump component that are fully separable from the diffusion component.

Second, we extend Maheu and McCurdy (2004) specification by allowing the jump intensity to be a non-affine function of the return volatility or its proxy. Studies in the continuous-time literature by Bates (2000), Duffie et al. (2000), and Pan (2002) point to the importance of incorporating volatility in the random jump intensity. They show that a high volatility before and during a market crash can increase the probability of jumps. Chernov et al. (1999) observe, however, that the return volatility tends to remain high after a market crash, while the arrival of jumps drops considerably after a crash. To accommodate both relationships, we use the absolute value of the equity returns as a measure of return volatility since it permits the jump intensity to be a non-affine function of the volatility. In this extended model, the GARCH multiplier is a scale factor for only the diffusion component and the contribution of each component is fully separable.

[1] Strictly speaking, the term "diffusion" is only applicable in the continuous-time setting. In the remainder of the paper, we use it loosely to refer to the component of the mixed GARCH-Jump model that captures the normal innovations.