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# Asymmetric Information and Volatility Forecasting in Commodity Futures Markets ☆

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ABSTRACT

This paper investigates the asymmetric characteristics of returns and volatilities of various Chinese commodity futures within the threshold stochastic volatility (THSV) framework with various distribution assumptions. To gauge the capabilities of THSV models in volatility forecasting, the values-at-risk (VaRs) for both long and short positions in these futures are estimated and analyzed. We demonstrate that the asymmetric THSV model outperforms the corresponding symmetric SV model, and that the THSV models with non-normal distributions can better fit the futures data than the standard THSV model. Our results clearly indicate that positive and negative news have asymmetric effects on the mean, variance, and variance persistence of all futures under consideration. We also document that modeling both the mean and variance asymmetries and the fat-tailed feature in return distributions is particularly important to accurately forecast the VaRs for long and short trading positions in commodity futures.



## 1. Introduction

It is documented in the literature that asset returns and volatilities respond differently to bad news than to good news. In particular, a negative market shock typically has a stronger impact on returns and volatilities than does a positive shock of the same magnitude. A profound understanding of this asymmetric effect is

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important to investors and risk managers, as it helps better characterize return dynamics and accurately forecast future volatilities, which are critical inputs to risk management and asset pricing models. The purpose of this paper is to investigate the asymmetric characteristics of returns and volatilities in Chinese commodity futures markets for copper, aluminum, natural rubber, and soybeans.

The asymmetric feature in asset means is first examined by Black (1976), who finds that an increase in implied volatility leads to a decline in returns greater in absolute magnitude than the increase in returns corresponding to a decrease in implied volatility of equivalent magnitude. Subsequently, many studies (Bekaert and Wu, 2000; Cappiello et al., 2006; Christie, 1982; Engle and Ng, 1993; Glosten et al., 1993; Nelson, 1991; Thomakos et al., 2008; Wu, 2001) explore the asymmetric response in volatilities of equity returns to good versus bad news in terms of positive versus negative lagged returns without explaining the origin of the news, and document that this volatility asymmetry is predominately attributed to either the leverage or the volatility feedback effect. The literature also finds that correlations among asset returns often increase when asset return volatilities rise or when the market is in a downturn (Ang and Chen, 2002; Bae et al., 2003; Karolyi and Stulz, 1996; Kroner and Ng, 1998). However, the research in this area focuses primarily on the equity market, with little work conducted on futures markets except by Perrakis and Khoury (1998) and Lien and Yang (2006). Perrakis and Khoury (1998) examine the theoretical and empirical implications of asymmetric information in canola, barley, and oats futures contracts, traded on the Winnipeg Commodity Exchange (WCE), and show that there is information asymmetry with known spot supplies in canola and barley. Lien and Yang (2006) explore the asymmetric effects of positive and negative spot-futures spreads on the return and the risk structure of currency spot and futures markets using a bivariate dynamic conditional correlation GARCH framework.

In contrast with previous studies, this paper intends to characterize both return and variance dynamics of various Chinese commodity futures, accounting for both the fat-tailed feature and asymmetric effects. To this end, we adopt the threshold stochastic volatility (THSV) approach proposed by So et al. (2002), and extend it to cases in which alternative distributions are allowed. In theory, the THSV approach is more flexible in describing mean and variance asymmetries in time series than is the threshold ARCH type model (Li and Lam, 1995; So et al., 2002; Xu, 2012). In particular, the asymmetric ARCH type model focuses on asymmetries in returns or volatilities alone, while the THSV approach enables us to investigate three asymmetric effects simultaneously: the asymmetries in returns, volatilities, as well as volatility persistence. So and Choi (2009) examine the Hong Kong stock market using the advanced threshold factor multivariate stochastic volatility (TFMSV) model, and confirm that the THSV approach can adequately capture asymmetries in both stock return and variance dynamics. For this reason, the THSV approach has received more attention in most recent empirical work. For example, Xu (2012) simulates and analyzes the Hang Seng Index (HSI), Nikkei 225 Index (Nikkei 225), and Standard & Poor's 500 (S&P 500) Index, while Liu and Zhou (2012) examine the asymmetric effects of risky events on Chinese stock markets using the standard THSV model. The standard THSV model assumes a normal return distribution, which fails to capture the non-normal properties observed in real data, such as skewness and excess kurtosis. Thus, this paper considers the student-*t*, generalized error, and mixture of normal distributions in the THSV model to better capture observed distribution characteristics in futures data.

To estimate the THSV model, we apply the Bayesian Markov chain Monte Carlo (MCMC) technique. The key to this method is to draw all parameters from their full conditional posterior distributions using Gibbs sampling procedure, which helps improve the efficiency of parameter estimation (Eraker et al., 2003). It is shown that the MCMC approach results in a smaller estimation error and a smaller root mean squared error than do other estimation approaches, such as the efficient method of moments (EMM), generalized method of moments (GMM), and quasi-maximum likelihood estimation (QMLE) (Andersen et al., 1999; Jacquier et al., 1994).

Based on the deviance information criterion (DIC), we first assess the performance of the asymmetric THSV model compared with the symmetric SV model to gauge the advantages of modeling mean and variance asymmetries. We also document the importance of incorporating these asymmetries and non-normal properties into the THSV approach to better fit futures data. With the most appropriate model, we then analyze the size, direction, and statistical significance of various asymmetric effects in our futures data series.

We further evaluate the ability of various models to forecast the one-day-ahead value-at-risk (VaR) for long and short trading positions in the commodity futures considered. Backtesting is conducted to