

An empirical study on information spillover effects between the Chinese copper futures market and spot market

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Received 1 August 2007; received in revised form 26 September 2007

Available online 4 October 2007

Abstract

This study employs a parametric approach based on TGARCH and GARCH models to estimate the VaR of the copper futures market and spot market in China. Considering the short selling mechanism in the futures market, the paper introduces two new notions: upside VaR and extreme upside risk spillover. And downside VaR and upside VaR are examined by using the above approach. Also, we use Kupiec's [P.H. Kupiec, Techniques for verifying the accuracy of risk measurement models, *Journal of Derivatives* 3 (1995) 73–84] backtest to test the power of our approaches. In addition, we investigate information spillover effects between the futures market and the spot market by employing a linear Granger causality test, and Granger causality tests in mean, volatility and risk respectively. Moreover, we also investigate the relationship between the futures market and the spot market by using a test based on a kernel function. Empirical results indicate that there exist significant two-way spillovers between the futures market and the spot market, and the spillovers from the futures market to the spot market are much more striking.

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Keywords: Futures market; Kernel function; Backtest; Information spillover; Granger causality; Conditional VaR; Extreme upside risk; Extreme downside risk

1. Introduction

China's futures market has experienced volatile fluctuations since its emergence during the late 1980s, bringing a great deal of uncertainties and risks to market participants. As a result, the futures market efficiency and the relationship between the futures market and the spot market have been major concerns for the supervision authorities and investors.

A large volume of study has been done on the relationship between the futures market and the spot market. Garbade and Silber [5] present a model for examining the price discovery role of futures prices and the effect of

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arbitrage on price changes in spot and the futures commodity markets. Haigh [11] use cointegration analysis to study the relationship between the prices of the futures market and the spot market. According to previous studies, for most futures products, there exists a cointegrating relationship between the prices of the futures market and the spot market. Hasbrouck [12] defines price discovery in terms of the variance of the innovations to the common factor, based on which the futures and the spot markets' relative contributions to this variance can be examined. Tse [29] investigates the minute-by-minute price discovery process and volatility spillovers between the Dow Jones Industrial Average (DJIA) index and the index futures. Tse and So [30] use data from Hong Kong's Hang Seng Index, Hang Seng Index futures and the Tracker Fund to examine price discovery function of the Hang Seng Index market via the Hasbrouck–Gonzalo and Granger information sharing techniques and the Multivariate Generalized Autoregressive Conditional Heteroskedasticity (M-GARCH) model. Empirical evidence shows that the movements of the three markets are interrelated and they have different degrees of information processing abilities.

In the Chinese future markets literature, Hua and Zhong [18] study the price discovery in the Chinese futures market using the Garbade and Silber [5] model. Tong [33] and Ma [34] investigate price discovery in the Mainland Chinese futures market. Hua and Zhong [17] use cointegration analysis to study the relationship between the futures price and spot price for copper and aluminum traded at SHFE (Shanghai Futures Exchange). Gao [35] studies the relationship between soybean futures price and spot price as well as the relationship between SHFE copper price and LME (London Metal Exchange) copper price. Pan et al. [26] study the risk contagion between Chinese oil market and overseas oil markets.

It is obvious that study on the relationship between the futures market and the spot market concentrates mainly on price discovery, and little research has been done on the information spillover, especially the risk spillover, between the two markets. To fill in this gap, this paper will examine the information spillovers between the futures market and spot market in China. We employ the methods developed by Hong [14] and Hong, Liu and Wang [16] and use their tests based on the kernel function to investigate the relationship between the futures market and the spot market for the first time. The kernel weight function ensures good power of the test method for using many lags, and Granger causality can be tested across a wide range of alternative hypotheses. Given the short selling mechanism in the futures market, we examine the risks for long and short positions separately. Considering the rising price tendency in the copper market after 2004, we firstly introduce the notions of upside VaR and extreme upside risk spillover.

Specifically, we study the VaR of the Chinese copper futures market and spot market by applying a parametric approach based on TGARCH and GARCH models. In addition, we investigate information spillovers between the futures market and the spot market by employing a linear Granger causality test, and Granger causality tests in mean, volatility and risk respectively.

The remainder of the paper is organized as follows: Section 2 introduces a VaR model, the notion of Granger causality and the methodology of various Granger causality tests. Section 3 gives a description of the variables used in the study and the descriptive statistics of their data series. Then estimation and empirical results are presented in Section 4. Finally, Section 5 summarizes and concludes the paper.

2. Methodology

2.1. VaR estimation

2.1.1. VaR

VaR (Value at Risk) is a standard quantitative measure of potential economic loss for market risk, which can quantify the potential risk to determine their significance. Jorion [19,20] defines VaR as: the maximum amount that can be lost within a specified time horizon and with a certain specified degree of confidence. Specifically, at the given confidence level of $1 - \alpha$ and given time horizon τ , VaR is the maximum amount that can be lost with the probability of α . In a statistical sense, VaR is minus the α -quantile of the conditional distribution of rate of return.

In the Chinese literature, most studies focus on VaR estimation for the Chinese stock market; little work has been done on the Chinese futures market. As the Chinese futures market shows a tendency of increasing uncertainties, it is of great importance to estimate VaR in China's futures market in order to quantify its risk, and to manage risks in the futures market effectively.

In this paper, we introduce a parametric approach based on TGARCH and GARCH models to study the potential risks in China's futures market and spot market. Considering the short selling mechanism, we study the risks associated

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