Pacific-Basin Finance Journal 30 (2014) 17–29

Contents lists available at ScienceDirect

Pacific-Basin Finance Journal

journal homepage: www.elsevier.com/locate/pacfin

Risk contributions of trading and non-trading hours: Evidence from Chinese commodity futures markets

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ARTICLE INFO

Article history:
Received 12 December 2013
Accepted 4 July 2014
Available online 11 July 2014

JEL classification:
C32
G15

Keywords:
Risk contribution
Value at risk
Expected shortfall
Futures markets
Trading hours
Non-trading hours

ABSTRACT

This paper examines the overall risks in Chinese copper, rubber, and soybean futures markets using a copula-VaR (value at risk) and copula-ES (expected shortfall) framework that explicitly accounts for both trading and non-trading information. Our results show that information accumulating during non-trading hours contributes substantially to overall risks, with non-trading VaR weights exceeding 40% in all these markets. In particular, the information during non-trading hours is more important than the information during trading hours in explaining the total risk of all three futures as measured by ESs and volatility weights. Moreover, the risk due to non-trading information increases with the length of non-trading periods, reflecting the fact that information accumulates continuously over time.

1. Introduction

Chinese futures markets trade only during the daytime hours from Monday to Friday, and the trading period is generally less than 7 h per day, which is less than one half of the non-trading period. Consequently, the financial information accumulating during non-trading hours (referred to in this paper as non-trading information) represents a significant source of overall market risk, and plays an important role in price discovery in Chinese financial markets. Non-trading information arises from public announcements made during non-trading hours in China as well as from trading activities in overseas markets. The purpose of this

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http://dx.doi.org/10.1016/j.pacfin.2014.07.005

paper is to measure the contribution of trading and non-trading hours to total market risk in major Chinese commodity futures markets.

To measure risk and risk contributions, we employ the value at risk (VaR) and expected shortfall (ES) methods. VaR is defined as the maximum loss of an investment at a certain confidence level over a specified horizon; it has become a widely accepted standard in the risk management industry after J.P. Morgan introduced their RiskMetrics document in 1994. ES is defined as the mean of all losses that are greater than (or equal to) the VaR at the confidence level (Engle and Manganelli, 1999). ES is considered an important alternative to VaR for the purpose of risk measurement, as it provides a better estimate of risk than VaR when loss distributions exhibit fat tails or empirical discreteness (Acerbi and Tasche, 2002; Frey and McNeil, 2002; Manganelli and Engle, 2001).[1]

It is noteworthy that VaR/ES estimates depend critically on the return distribution assumed for a particular market. The joint distribution of multi-asset returns or risk factors is typically assumed to be multivariate normal with a linear correlation matrix. However, it is a stylized fact that financial asset returns exhibit non-normal properties and non-linear dependencies. To accommodate these features, some finance researchers adopt the copula method to aggregate distributions of financial returns. The copula approach provides considerable flexibility in modeling multivariate distributions, since it allows us to select a rich dependence structure while preserving non-normal properties of marginal distributions.[2]

In this context, we examine the overall risks in various futures markets using the copula approach, explicitly accounting for information flows during both trading and non-trading periods in these markets by implementing the following steps. First, we apply the extreme value theory (EVT) to form the distinct distributions of trading and non-trading returns to capture deviations from normality, such as skewness and fat-tails. Second, we combine the trading and non-trading return distributions into a joint distribution using the copula function that best fits our data. This joint return distribution is utilized to estimate overall market risk as measured by VaR and ES, which are referred to as integrated VaR and integrated ES in our paper. Third, we quantify the risk contributions of the trading and non-trading hours by decomposing integrated VaR/ES into VaRs/ESs of trading and non-trading returns. Fourth, we examine the contribution of non-trading returns to the mean and volatility of close-to-close returns in order to provide a full picture of the role of non-trading information in explaining overall market risk. Finally, we investigate whether longer non-trading periods (such as weekends and holidays) contain more (or more important) information about returns than do shorter trading periods.

Most previous research on futures markets investigates price discovery and information flow across markets (Booth et al., 1996; Covrig et al., 2004), hedging with futures (Wang and Xie, 2011), as well as risk and return characteristics of futures (Liu et al., 2014; Thomakos et al., 2008) based on close-to-close returns. However, risk estimates based on close-to-close returns might be inaccurate, as they ignore the different risk characteristics of trading and non-trading returns. The importance of non-trading information in price discovery and market volatility has been well documented in the literature. For instance, Tsiakas (2008) finds that the size and predictive ability of non-trading information for both US and European stock markets are substantial. Taylor (2007) also documents the significant impact of overnight information on information flow in the regular S&P 500 futures market. In addition, Cliff et al. (2008) find that night returns are higher than day returns in US equity markets, and conclude that the US equity premium over the last decade is solely due to overnight returns.

Most studies focus on mature futures markets, such as US and European markets rather than emerging markets. In contrast, our paper explores Chinese commodity futures, which are the most dramatically expanding markets in the world over the past three decades. In fact, by 2009 Chinese commodity futures markets ranked first in the world in terms of trading volume, accounting for 43% of the world's total trading volume.[3] However, Chinese futures markets are still relatively immature, and display strong regional

[1] The major drawback of VaR is that it is not sub-additive, which means that the VaR of a portfolio can be larger or smaller than the sum of the VaRs of its components. Moreover, it cannot measure the expected loss resulting from extremely unlikely market factor changes.

[2] Ward and Lee (2002) use a multivariate normal copula to aggregate different types of risks to create an integrated risk distribution for an insurance company. Rosenberg and Schuermann (2006) combine market, credit, and operational risks with copulas to obtain a total risk distribution for a financial institution, and find that the copula-based approach is more accurate than other methods at estimating the overall risk.

[3] Source: Operation Report of Regional Finance in China in 2009, People's Bank of China, 2010. http://www.pbc.gov.cn.