Global Finance Journal 26 (2015) 18–28

Contents lists available at ScienceDirect

Global Finance Journal

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

A method for evaluating the extreme risk sources of financial markets: The case of stock markets in China ☆

Junpeng Di *, Pingfang Zhu

Shanghai Academy of Social Sciences, Shanghai, China

ARTICLE INFO

Available online 20 January 2015

JEL classification:
C11
C21
G32

Keywords:
Bayesian quantile regression
CVaR–Granger causality test
Extreme risk
Source

ABSTRACT

Risk contagion has attracted increasing research attention in recent years. In this paper, we combined conditional Value at Risk (CVaR), Bayesian quantile regression and Granger causality test to propose a Bayesian CVaR–Granger causality test method, which is an efficient tool in analyzing sources of extreme risks in a financial market. Using this method, we determined the sources of extreme risks in major stock markets in China.

1. Introduction

Owing to rapid economic globalization and financial development, interactions among global capital markets have become closer. Furthermore, people now pay more attention to capital market risks. Related studies have focused on risk measurement and risk transfer (also called “contagion”) among different markets. Risk contagion is essentially about information spillovers between markets. It has a long history, dating back to the 1990s, and examples include the meteor showers hypothesis and the heat waves hypothesis proposed by Engle, Ito, and Lin (1990).

However, with the frequent financial crises in recent years, more attention has been directed towards extreme risk markets, not just concerning information overflow of returns and volatilities in the average sense. Extreme volatility can potentially destroy an economy, thus, extreme risk infection has caught the interest of investors and financial regulators.

☆ We are grateful for valuable suggestions from my anonymous referees and the editor (Professor Manuchehr Shahrokhi). We would also like to thank the support from the National Natural Science Foundation of China (NSFC, 71271139).

* Corresponding author at: No. 7/622 Huaihai Middle Road, Shanghai 200020, China. Tel.: +86 13302016182.
E-mail address: dijunpeng@sass.org.cn (J. Di).

http://dx.doi.org/10.1016/j.gfj.2015.01.002
1044-0283/© 2015 Published by Elsevier Inc.

The traditional way of determining extreme risk contagion is to divide samples according to important events and then capture the extreme return changes that occur between markets. However, one problem with this method is that, it is unable to sufficiently describe market risk contagion under an extreme environment. This is mainly due to the fact that abnormal return fluctuations may be caused by unknown and inexplicable events. Hong, Cheng, Liu, and Wang (2004) provided a possible solution to this problem.

Studying risk infection, Hong et al. (2004) expanded market return (first-order moment) and volatility (second-order moment) to high order moment (e.g., skewness and kurtosis) to study risk infection, and then proposed the risk-Granger causality test. They examined the big risk spillover in the whole sample interval (from January 2, 1995 to April 4, 2003) between China's stock market and other main stock markets in the world. Their results showed that under the risk level of 10%, felling information of B shares can be used to predict the possibility of sharp felling of A shares, and vice versa. Furthermore, they found that there exists a strong risk spillover effect among A share, B share and H share markets as well as among B share, H share and Hong Kong markets. By contrast, there is no significant spillover effect among the B-share and H-share stock markets and those in Japan and the U.S. There is also no risk spillover effect between the A-share market and the stock markets in Japan and the United States (Hong et al., 2004).

Later on, Hong, Liu, and Wang (2009) modified this method to make it more systematic. Using the modified method, Li, Hong, and Wang (2011) found that, before and after the United States subprime mortgage crisis, both the U.S. and Hong Kong stock markets have average volatility and risk spillover effects on the A-share market. Moreover, these spillover effects increased after the crisis.

The risk-Granger method proposed by Hong et al. (2009) essentially tests the correlation between the loss times of two markets, which exceeds a certain value (e.g., Value at Risk). This means that when extreme damage happens in a market after which another market (maybe a lag period) faces extreme losses, if the correlation is statistically significant, then there is a risk-Granger relationship between them. This method provides an important way by which to examine extreme risk contagion. However, the method can only provide the evidence of the existence of extreme risk and risk transfer direction, but not give the actual risk value. This leads us to the following questions: "When a market risk occurs, how much impact would it have on another market?" and "What is the extent to which risk in the latter is caused by the former?"

For the reasons stated above, this article combines conditional VaR (CVaR),[1] Bayesian quantile regression, and Granger causality test, after which a Bayesian CVaR–Granger method is proposed to examine research risk contagion in the financial markets. First, the Bayesian CVaR–Granger causality test focuses on extremely high or low returns (e.g., in the 0.05 or 0.95 quantiles) in a whole sample, and identifies the sources of market risks under extreme condition. The method can overcome the randomness caused by dividing a sample into several intervals. Second, we will obtain the posterior distributions of extreme risk coefficients using the Bayesian quantile regression method, which provides a more comprehensive understanding of market risks. Third, with the advancement of internationalization and marketization of China's financial market, the country's stock markets are influenced by the activities of both the international and domestic markets. Thus, we will study the possible extreme risk sources in the Chinese stock markets as an application of the proposed Bayesian CVaR–Granger method.

2. Bayesian CVaR–Granger causality test

2.1. CVaR–Granger causality test

Here, the CVaR is defined as a level of return Y_t for a certain period t that is exceeded with probability α condition on information vector X:

$$\mathrm{CVaR}_\alpha = \inf\{y : P(Y_t \le y) \ge 1-\alpha | X_t\} = F_y^{-1}(1-\alpha|X_t)$$

where $F_y^{-1}(\cdot\ |X_t)$ is an inverse of the $F_y(\cdot\ |X_t)$ or is called as conditional quantile function.

[1] CVaR is different from VaR and CAViaR. Most existing VaR estimation estimates the distribution of the returns and then recovers its quantile. However, CVaR models the quantile directly. And CVaR models risk condition on market factors. On the other hand, CAViaR (Engle & Manganelli, 2004) stresses that the distribution of portfolio returns typically changes over time, so the risk is conditional on lagged returns. In this sense, CAViaR is a special case of CVaR.