Systematic Risk Measurement of Financial Institutions in China

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Abstract: Preventing systemic financial risks and maintaining financial stability are the focus of government departments at present. The risks of financial institutions are reflected in stock returns. Therefore, this paper draws lessons from the RMES risk measurement method of Brownlees & Engle (2016). Based on the daily yield data of 39 listed financial institutions, the systemic risk of my financial institutions is measured. The measurement results show that the method can accurately identify the systemic risk trends and major risk events of financial institutions in China.

1. Introduction

The report of the Nineteenth National Congress pointed out that "we should resolutely guard against and defuse financial risks". President Xi Jinping also stressed that we should firmly stick to the bottom line of non-occurrence of systemic financial risks [1]. Thus, how to prevent and resolve systemic financial risks is an urgent problem for the Chinese government. The occurrence of systemic risks is the result of the interaction of the inherent vulnerability of the financial system and the impact of external factors. Extreme risk events are one of the most important factors affecting systemic financial risks [2]. Financial institutions are the core sectors of the modern economy. Therefore, it is of great academic value and practical significance to reasonably evaluate and accurately measure the systemic risks of financial institutions in China. This provides a reference for effectively identifying, preventing and resolving systemic financial risks.

2. Systematic Risk Measurement Method and Data Description of Financial Institutions

After the outbreak of the global financial crisis in 2007-2009, systemic risk has become a hot issue of concern to all walks of life. A large number of studies on systemic financial risk have emerged, among which the measurement of systemic financial risk has become a key issue in this field [3]. Domestic and foreign scholars often use the CoVaR method proposed by Adrian & Brunnermeier (2011) to measure systemic financial risks. This method is based on the bottom-up perspective to examine the impact of a single financial institution in a difficult situation on the entire financial system [4]. In order to overcome the limitation of the CoVaR method, Acharya et al. (2010) takes extreme risk events into account and uses the expectation mean form to analyze them. Based on the short-term marginal expected loss (MES) method, it examines the systemic financial risk of a single financial institution. Contribution [5]. However, short-term MES pays too much attention to short-term shocks and cannot capture the long-term dynamic changes of systemic financial risks. The short-term fluctuations of the market may be interfered by the news and policy. Regulators should pay more attention to the long-term dynamic changes of financial risks of financial institutions [6]. Therefore, Brownlees & Engle (2011, 2016) further refined the approach to extend the MES of a single financial institution into a long-term marginal expected loss (LRMES). Therefore, this paper draws on the method of Brownlees & Engle (2011, 2016) to measure the systemic risk of Chinese financial institutions [7].

2.1 LRMES Measurement Method

The calculation of long-term marginal expected loss (LRMES) requires the use of nonparametric

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bootstrap method, which is more complex, but Acharya et al. (2012) points out that：

$$LRMES \approx 1 - \exp\left(-18 \times MES_{i,t}\right) \tag{1}$$

Therefore, if we want to calculate the LRMES of financial institutions, we need to measure the short-term MES first. For the measurement of MES, this paper draws on the research ideas of Brownlees & Engle (2011, 2016). First, establish a binary conditional heteroscedasticity model to express the dynamics of the financial institution i and the daily financial rate of the entire financial market, as shown in formula (1).

$$r_{m,t} = \sigma_{m,t}\varepsilon_{m,t} r_{i,t} = \sigma_{i,t}\rho_{i,t}\varepsilon_{i,t} + \sigma_{i,t}\sqrt{1-\rho^2{}_{i,t}\varepsilon_{i,t}}, \left(\varepsilon_{m,t}, \varepsilon_{i,t}\right) \sim F \tag{2}$$

Among them, $r_{m,t}$ and $r_{i,t}$ financial markets and financial institutions I have market returns on day t, $\sigma_{m,t}$ and $\sigma_{i,t}$ refer to the conditional standard deviation of market and financial institutions I respectively. $\rho_{i,t}$ represents conditional correlation coefficients of mechanism I and market. Shock $\left(\varepsilon_{m,t}, \varepsilon_{i,t}\right)$ is independent and identical distribution with time, with mean value of 0, variance of 1 and covariance of 0.

Brownlees & Engle (2011, 2016) considers that MES of mechanism i in advance of t period can be expressed by volatility, correlation coefficient and tail expectation function.

$$\begin{aligned} MES_{i,t-1}(c) &= E_{t-1}(r_{i,t} \mid r_{m,t} < c) = \sigma_{i,t}E_{t-1}(\varepsilon_{i,t} \mid \varepsilon_{m,t} < \frac{c}{\sigma_{m,t}}) \\ &= \sigma_{i,t}E_{t-1}(\rho_{t-1}\varepsilon_{m,t} + \sigma_{i,t}\sqrt{1-\rho^2{}_t}\varepsilon_{i,t} \mid \varepsilon_{m,t} < \frac{c}{\sigma_{m,t}}) \\ &= \sigma_{i,t}E_{t-1}\rho_{i,t}(\varepsilon_{i,t} \mid \varepsilon_{i,t} < \frac{c}{\sigma_{m,t}}) + \sigma_{i,t}\sqrt{1-\rho^2{}_t}E_{t-1}(\varepsilon_{i,t} \mid \varepsilon_{m,t} < \frac{c}{\sigma_{m,t}}) \end{aligned} \tag{3}$$

In order to estimate the tail expectation of financial market for a single financial institution, we use Acharya et al. (2012) to solve the problem step by step. The result of this method is robust and does not depend strictly on a certain distribution. The first two steps can estimate the volatility and correlation coefficient. The solution to the tail expectation is relatively complicated. The nonparametric method proposed by Scaillet (2005) is used to estimate the tail expectation $E(\varepsilon_{i,t} \mid \varepsilon_{m,t} < k)$ and $E(\varepsilon_{i,t} \mid \varepsilon_{i,t} < k)$, and $c/\sigma_{i,t} = k$ finally finds the short-term MES.

The MES obtained by the above method is the daily data, while the LRMES is the monthly or quarterly data. According to the needs of this study, referring to the practice of Acharya et al. (2012), we first convert the daily MES to the monthly MES, and then calculate the monthly LRMES of a single financial institution according to the above formula (1). Finally, the weighted average of each company's total assets is used to calculate the total financial risk of financial institutions.

2.2 Data description

Based on the industry classification of the Securities Regulatory Commission, 39 financial companies listed in A-share market are selected as samples of Chinese financial institutions. The samples include 16 banks, 4 insurance companies and 19 securities companies with the highest market value, as shown in Table 1. The selected companies account for about 70% of the listed financial institutions in China and can better represent China. The general situation of the financial industry. The yield of a single financial institution is obtained from the closing price. The market yield index uses the CSI 300 financial index yield. Since most insurance companies have been listed in 2007, it is a comprehensive measure of the staged characteristics and data of the systemic risks of Chinese financial institutions. The availability of the sample interval is from January 2007 to

September 2018, the data comes from the wind database and Zhongcai.

Table 1.Sample list

Banking	Insurance industry	Securities business
Industrial and Commercial Bank of China	China safe	citic securities
Bank for economic construction	China Life Insurance	Haitong Securities
Agricultural Bank	China Pacific Insurance	Guangfa securities
Bank of China	Xinhua Insurance	China merchants securities
China Merchants Bank		General securities
Bank of Communications		Changjiang securities
Industrial Bank		Societe Generale Securities
Pudong Development Bank		Founder securities
CITIC Bank		Guoyuan securities
Minsheng Bank		Southwest securities
Ping An Bank		Northeast securities
Vast banks		Shanxi securities
Bank of Beijing		Western securities
Huaxia Bank		Guojin securities
Bank of Ningbo		Pacific ocean
Bank of Nanjing		Jinlong shares
		National Sheng Jin Control
		State Sea Securities
		Soochow Securities

3. Calculation result

3.1 Systematic Financial Risk of Financial Institutions

Based on the weighted average value of the monthly LRMES index of 39 Financial institutions, we construct the measurement index of systemic risk of Chinese financial institutions and draw it in Figure 1. From the figure, it can be seen clearly that the systemic risk of Chinese financial institutions appeared a prominent peak during the 2007-2008 international financial crisis and the "stock disaster" in June 2015, especially during the financial crisis. It reflects the long-lasting and destructive characteristics of this financial risk. In response to the global financial crisis, after the introduction of the 4 trillion yuan stimulus policy by the Chinese government in December 2008, China's economic performance has improved, and the systemic risk of financial institutions has dropped significantly. Affected by the money shortage caused by the mismatch of commercial banks in June 2013 and the Sino-US trade war in March 2018, the systemic risk of Chinese financial institutions rose slightly. In general, the dynamic trend of LRMES and The actual situation in China is more consistent.

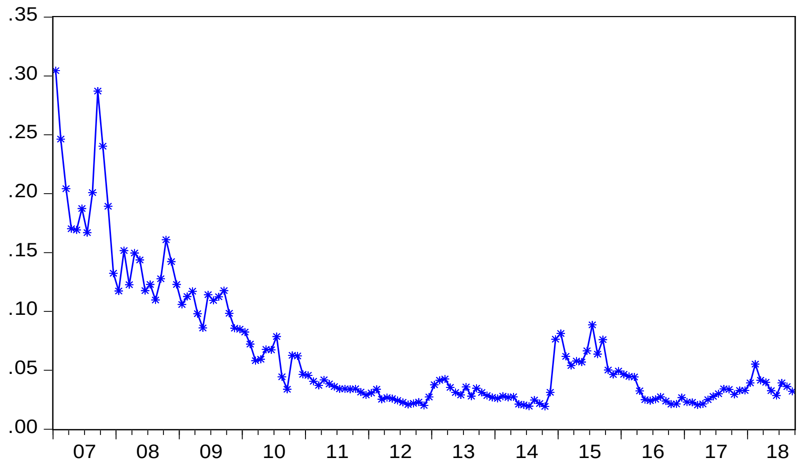

Fig. 1. Trend of LRMES in China's Financial Institutions

3.2 Systematic risk of sub-industry

From the systemic risk of the industry, during the financial crisis, the LRMES of all financial sub-industries reached its peak. After the introduction of quantitative easing policy by the Federal Reserve, the value of risk declined. The trend of 2010-2014 was relatively stable. Affected by the "Five Countries" and "Historic Money Shortage" launched by the State Council, there was a slight rebound [8]. During the stock market disaster in 2014-2015, due to the influence of off-exchange funds, the Chinese stock market experienced a “leverage bull market”, and then the strong de-leverage measures led to the withdrawal of large amounts of funds from the stock market, which led to the bursting of the bubble and eventually formed a “share disaster”, sub-industry Systemic risks have risen again. As far as the industry is concerned, the insurance industry has accumulated more systemic risks, followed by the banking industry. Overall, affected by the industry's relevance, the trend of each financial sub-industry is similar. In addition, the trend of systemic risk is closely related to the trend of A-share market.

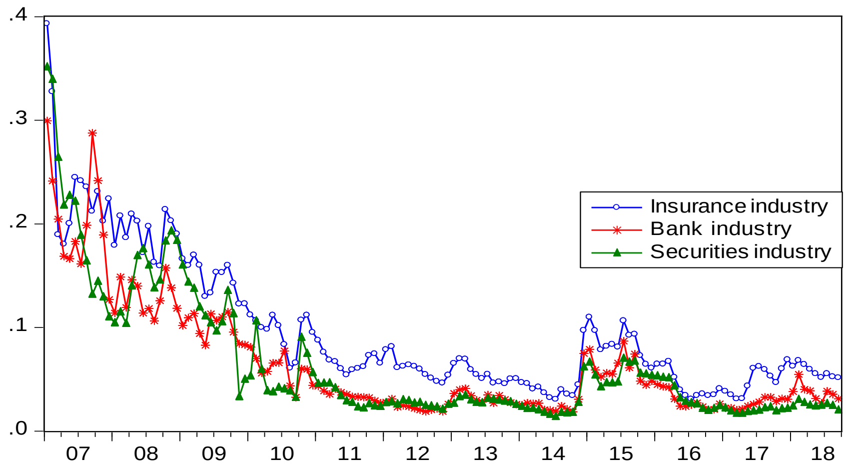

Fig.2. LRMES Trends in the Financial Industry

4. Conclusion

This paper uses LRMES model to measure the systemic risk of financial institutions in China. The results show that the systemic risk of financial institutions in China reaches its peak under the influence of the international financial crisis and the "stock market disaster". As far as the financial sub-industry is concerned, the systemic risk of the insurance industry is relatively high, followed by the banking industry. From the trend analysis, the LRMES trend of the three sub-industries is basically the same, which verifies the linkage between the financial industry. In short, systemic financial risks are greatly affected by extreme risk events, and linkage between industries is a characteristic of systemic risks. Therefore, macro prudential supervision is a necessary measure to prevent systemic risks.

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