Systemic Risk Contribution and Systemic Risk Taking of China's Financial Industry

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Abstract

In this paper, we study the importance of China's financial industry system from the perspective of systematic risk contribution and systematic risk taking. The results show that the risk spillover from diversified financial industry and insurance industry to other financial industry is greater than they commitment. The risk spillover from securities industry to other financial industry is less than its commitment. In the financial crisis and "crash" period, the systemic risk contribution and the risk taking of financial institutions are greater than the sample mean, especially during the financial crisis. The risk spillover between each financial industry and the financial system is positive and asymmetry. The order of systemic risk contribution from big to small is banking, insurance, securities, real estate and multiple financial. The order of systemic risk taking from big to small is banking, insurance, securities, real estate, diversified financial.

Keywords: systemic risk contribution; risk taking; system importance; risk spillover

1. Introduction and literature review

After the outbreak of the international financial crisis in 2007-2009, many countries advocated systematic risk supervision. On September 12, 2010, the central bank representatives of 27 member states agreed on "Basel III" to strengthen banking supervision, raising the number and quality requirements of bank capital. The regulation reform of "Basel III" is mainly reflected in the supervision and regulation of banking and systemic risk. The reform on the supervision of systemic risk mainly includes: proposing counter-cyclical capital regulation measures and strengthening the regulation of systemically important institutions. On December 29, 2015, People's Bank of China announced that it would upgrade the existing differential reserve dynamic adjustment and agreement loan management mechanism to Macro Prudential Assessment system (MPA) in 2016. According to MPA, the stability of individual financial institutions or financial markets does not represent the entire financial system stability, arising the importance of system identification of all financial institutions in the financial system at the historic moment, and many researches generally believe that the importance of financial system can be defined by measuring the financial systemic risk effect of individual financial institutions, while the effect of financial institutions on financial systemic is related to two aspects.

On the first aspect, when the financial system is in trouble, the risk of individual financial institutions is greater, indicating that the contribution of financial institutions to the financial system is greater, so it is more important to the financial system; on the second aspect, when a single financial institution is at high risk, the contribution to the systemic risk is greater, the indicating that the financial institutions is more important to the system; however, is the contribution to the systemic risk of financial industry consistent with its systemic risk sequence? Does the financial sector which has the greatest systemic risk contribution undertake the biggest systemic risk? What are the characteristics of systemic risk spillovers among the financial industries? The literatures on measuring the importance of financial institution system at home and abroad from the perspective of systemic risk bearing are as follows: Acharya (2010) stressed that in the context of the outbreak of systemic risk, for individual financial institutions that are relative to the degree of the financial system of capital shortage, and on the basis of the expected loss ES.

Marginal expected loss (MES) method was established, and when measuring the yield of the entire financial system significantly declines, the expected loss of financial institutions is made by calculating the extent of a single financial institution's overall capital shortage for the financial system to measure the importance of the institution.

Acharya, et al. (2012) included bank size, leverage and internal links, etc. into the consideration of the expected capital shortfall measure, measuring capital shortfall of all banks when the bank is in crisis situations. Brownlees (2011) et al. questioned the key assumption of Acharya (2010), namely when a financial institution faces capital shortage, it may be acquired, or can also raise new capital or face bankruptcy, and the vacancy of financial services will be made up by other financial institutions, so that individual financial institutions will have little impact on the financial system. However, if the conditions are not met, that is, if a single financial institution faces capital shortage when the financial system suffers capital constraint of the whole financial system, and it cannot be made up for normally, it will severely weaken financial intermediary service function of the financial sector. Brownlees et al. (2011) put forward the systemic risk index (SRISK), and different from MES, SRISK refers to the expected capital gap of individual financial institutions when the future systemic financial crisis occurs, with the emphasis on identifying the systematic importance of financial institutions on the basis of long-term shortage of capital. Banulescu et al. (2015), based on MES, introduced financial institutions' market value weights to establish CES method, which is used to explain the characteristics of China "too related to fail" and "too big to fail". In China, the literatures to measure the importance of China's financial industry system from the systemic risk contribution, are as follows: Guo Weidong (2013) and Song Qinghua (2014) respectively used the MES model and DCC-GARCH-MES model to measure the contribution of 14 listed commercial banks in China to the marginal risk of the financial system. Liu Lu et al. (2016) used the DCC-GARCH-MES model to measure systemic risk in China's insurance industry. Fan Xiaoyun et al. (2011), Zhou Qiang et al. (2014) and Bu Lin et al. (2015) compared CoVaR, MES and CES methods. Su Mingzheng et al. (2013) and Zhang Tianding et al. (2016) used the CES model to measure the importance of China's financial institution system. Liang Qi etc. (2013) calculated the capital shortage of 34 listed banks, insurance companies, securities companies based on SRISK method to evaluate its system importance, and the results showed that the system importance of larger financial institutions rank top, and some financial institutions' system importance of regional scale ranks top.

The literatures on measuring the importance of financial institution system from the perspective of systemic risk contribution at home and abroad are as follows: Adrian (2008) et al. started from the perspective of individual financial institutions to put ward model, and used it to measure individual financial institution's contribution towards the systemic risk to measure the importance of financial institution system. Once the method was put forward, many scholars at home and abroad took a large number of application and improvement. For example, Lopez-Espinosa et al. (2012) considered the asymmetric tail connection between single bank and banking system to promote it to the asymmetric state. Reboredo et al. (2015) used the Copula function to effectively match the advantages of financial data and establish the Copula-CoVaR method to measure the systemic risk of countries before and after the European debt crisis. Liu Xiaoxing et al. (2011) used the method of combining Extreme Value Theory (hereinafter referred to as EVT) and Copulas function with the consideration of the importance of the extreme situation of financial market to establish EVT-Copula-CoVaR model to research the stock market risk spillover. Baraka et al. (2014), Chen Shoudong et al. (2014), Xu Yingmei (2015), Chen Jianqing (2015), Zhou Tianyun et al. (2014), Wang Yongqiao et al. (2012), Liu Xiangli et al. (2014) used CoVaR or improved CoVaR to make empirical research on China's financial market systemic risk.

Above, from the perspective of individual financial institutions, by measuring the contribution of individual contribution in the systemic risk, the systemic risk of financial institutions is measured. In essence, it is individual financial institution's risk spillover for the financial system and financial institutions belong to the members of the financial system, so they are inevitably affected by the financial system's a whole environment spillover; however, many literatures use CoVaR model to measure the importance of individual financial institution system, only based on risk spillover of financial institutions to the financial system, without taking its financial system's self risk spillover into account. But in the recent financial crisis, Bear Stearns, Lehman Brothers were closed in succession, but J.P. Morgan Chase & Co. as the investment bank as well was not affected, but to get more profit; there is a similar situation in Europe.

These phenomena show us that once the outbreak of systemic financial risk, the biggest impact of financial institutions is not necessarily the one with system as the most important, or the largest one, which reminds the educational field and the industry that they should consider the risk of all financial industry when the whole financial system in at high risk based on the contribution of individual financial institution to systemic risk of financial system as a recognition of the importance of financial institution system.

Different from the existing literatures that mostly start from one aspect, or individual financial institution, or the entire financial system to measure the importance of Chinese financial institution system without considering these two aspects, this paper respectively measures Chinese financial industry's contribution to the systemic risk and systemic risk undertaking, and at the same time, considers two aspects influencing the importance of financial industry system to firstly measure the important of China's financial sectors to the entire financial system, and further study the systemic risk spillover between all of China's financial sectors.

Next, the paper firstly introduces CoVaR model proposed by Adrian et al. (2016). Secondly, to contrast the differences in starting from individual financial institution and the whole financial market to identify the importance of financial system, and symmetry of China's financial industry system risk spillover, this paper respectively starts from the perspective of the above two, and takes the industry as the unit to measure systemic risk contribution and risk bearing of China's financial industry. Thirdly, it is convenient to examine systematically the spillover of systemic risks between China's financial sectors more concretely. Finally, the conclusion of this paper is made.

2. Introduction of Model

Based on Exposure- model proposed by Adrian et al. (2016), when using market data to capture that the whole the financial system is at increased risk, the greater the change of VaR of financial sector exposed in systemic risk is, the greater the risk the systemic risk of the financial industry is. Adrian et al. (2016) pointed out that the advantages of measurement method are as follows: (1) $\Delta \mathrm{CoVaR}$ can be calculated to measure the systemic risk contribution of individual financial institutions to the financial system. (2) Exposure- $\Delta \mathrm{CoVaR}$ can be calculated to measure the risk of the financial system, and for the influence on the assets of individual financial institutions exposed to the systemic impact, the greater the influence is, the greater the systemic risk is; (3) Network- $\Delta \mathrm{CoVaR}$ can be calculated and measured, when any institution in the financial system is at risk, another institution's CoVaR changes, which can measure the risk spillover of the whole financial Network; (4) $\Delta \mathrm{CoVaR}$ can be further extended to other risk measurement methods, such as CoES. Similarly, it can be extended to other risk measures.

2.1 Static Exposure- $\Delta \mathrm{CoVaR}$ model

According to the definition of CoVaR in Adrian and Brunnermeier (2016), when the whole financial system s is under extreme risk pressure, the risk value (CoVaR) of the industry j:

$$\Pr(X^j \le CoVaR_q^{j|C(X^s)} \mid C(X^s)) = q \quad (1)$$

Wherein, $C(X^s)$ means that the financial system s is in a state of extreme risk X. The risk spillover from overall system s to the industry j is:

$$\Delta CoVaR_q^{j|s} = CoVaR_q^{j|x^s = VaR_q^s} - CoVaR_q^{j|x^s = VaR_{0.5}^s} \quad (2)$$

Namely, the difference of VaR of industry j under the condition that when the income of s is at q and 0.5 quantile is defined as the risk spillover from the system s to the industry j. Because we focus on loss, corresponding to the left tail distribution of random variables, so the value of q is generally small, and the value of q in the existing literatures is 0.1, 0.05, or 0.01. In this paper, the value of q in the empirical part is 0.01.

2.2 Dynamic Exposure- $\Delta \mathrm{CoVaR}$

Based on the dynamic VaR model proposed by Adrian et al. (2016), the data generation process of X^s and X^j is set as follows:

$$X_t^s = \alpha^s + \gamma^s M_{t-1} + \varepsilon_t^s \quad (3) \quad X_t^j = \alpha^{j|s} + \beta^{j|s} X_t^s + \gamma^{j|s} M_{t-1} + \varepsilon_t^{j|s} \quad (4)$$

Here, M_{t-1} is the vector quantity of hysteretic state variable. Through quantile regression, the quantile regression coefficient of formula (3) and (4) is obtained, so as to get $VaR_{q,t}^{s}$ and $CoVaR_{q,t}^{j|s}$.

$$VaR_{q,t}^{s} = \hat{\alpha}_{q}^{s} + \hat{\gamma}_{q}^{s} M_{t-1} \quad (5)$$

$$CoVaR_{q,t}^{j|s} = \hat{\alpha}_{q}^{j|s} + \hat{\beta}_{q}^{j|s} VaR_{q,t}^{s} + \hat{\gamma}_{q}^{j|s} M_{t-1} \quad (6)$$

According to formula (5) and (6), $\Delta CoVaR_{q,t}^{j|s}$ is obtained.

$$\Delta CoVaR_{q,t}^{j|s} = CoVaR_{q,t}^{j|x^{s}=VaR_{q}^{s}} - CoVaR_{0.5,t}^{j|x^{s}=VaR_{0.5}^{s}}$$

$$= \hat{\beta}_{q}^{j|s}\left(VaR_{q,t}^{s} - VaR_{0.5,t}^{s}\right) \quad (7)$$

2.3 ΔCoVaR **and Network-** ΔCoVaR

If s and j exchange, it can start from the risk of the individual financial industry, to use $\Delta\mathrm{CoVaR}^{s|j}$ to measures the marginal contribution of the whole financial systemic risk when individual financial industry is in a state of high risk, so as to measure the importance of financial industry system, taken as ΔCoVaR.

If the above s is defined as financial institution or financial industry similar to j, $\Delta\mathrm{CoVaR}^{j|i}$ will be able to measure the risk spillover of any two financial industries or financial institutions in the financial network, taken as: Network-ΔCoVaR.

3. Empirical Analysis

3.1 Data selection and description

The second-level industry index of Shenyin Wanguo Securities refers to second-level industry stock price index compiled based on industry classification standards by China Securities Regulatory Commission, which is widely used by domestic scholars. Therefore, the paper also selects the second-level industry index of Shenyin Wanguo Securities including the banking, insurance, diversified finance, securities and real estate industry from January 18, 2007 to February 8, 2017. Excluding the data of inconsistent business dates, 2323 sets of valid data are obtained by adopting formula $r_t = 100 \times \ln(p_t / p_{t-1})$, which includes price series in the banking, insurance, diversified finance, securities and real estate industries; r_t refers to the corresponding yield data after conversion, and the yield rate of the financial system is obtained through weighting of daily yield rate all financial sub-sectors with calculation formula of $r_t^{s} = \sum_{i} \frac{\omega^{j}}{\sum_{j} \omega^{j}} r_t^{i}$. The weighting of most literatures is calculated according to general capital. However, due to the actual situation of China circulation stock accounting for relatively low rate of general capital, the utilization of capital stock in circulation is able to precisely reflect the real situation of China's financial industry. Therefore, the weight ω^{j} in the paper adopts the proportion that capital stock in circulation of all indexes accounts for general capital stock in circulation of the entire financial system. The data in this article are derived from the Wind database.

Table 1 shows the proportion of capital stock in circulation in all financial sectors and general capital stock in circulation of the entire financial industry. According to the calculation results show that the banking industry is the largest proportion among the second-level Chinese financial sub-industry with weight of 0.7433, a figure which is greatly larger than weight of other financial industries. The second largest financial industry refers to the real estate industry with the weight of 0.1348 followed by the securities industry, insurance industry and diversified finance industry. The sequence representing yield rate of the entire financial system can be obtained according to the proportion of all financial sectors in Table 1 and the daily yield rate data in all financial industries.

Table 1:The weight of financial industries accounts for the financial system

	Bank	real estate	Securities	insurance	diversified finance
Circulating share capital (100 million yuan)	10401.9700	1886.1940	1098.6270	410.0722	196.6271
Weight	0.7433	0.1348	0.0785	0.0293	0.0141
Order	1	2	3	4	5

Table 2 describes the basic characteristics of the banking, insurance, diversified finance, securities, real estate and financial system yield rate. It shows that the standard deviation of the securities industry in the sample range is 2.9831 which is higher than that of other industries, indicating that the largest fluctuation in the securities industry within the sample range. The average yield rate in the sample range shows that the maximum average yield is diversified finance sector with 0.0463 yield rate, and the real estate industry is the second largest financial industry with average yield of 0.0417 followed by the banking and securities industry. The insurance industry is the minimum average yield of all financial industries where it is below 0 and that of others is greater than 0. Meanwhile, the largest yield is made in diversified finance industry, and however, the corresponding volatility is also larger, which meets the characteristic of financial market of high risk with high income. As for the yield in all sectors, the larger variation range of yield are securities industry and insurance industry, while it is slight in the real estate industry. The kurtosis of yield in each sector is greater than 3 and is characterized by sharp peak and heavy tail. The yield in all financial industries is in left avertence, and the P-value tested by the Jarque-Bera of the yield sequence is close to zero, the original hypothesis is rejected, which means the yield sequence is against normal distribution. This paper calculates model parameters by adopting the quantile regression and it does not require that the sequence must comply with the normal distribution. The P-value of stationary test statistic is close to zero, and the original hypothesis that the unit root is existed is rejected, which means the yield sequence is in a stationary sequence.

In this paper, the state variables from January 18, 2007 to February 8, 2017 are selected; the state variables and their methods of calculation are as follows: Shanghai-Shenzhen 300 index volatility, the standard deviation obtained from the 22-day rolling yield represents the market volatility; Trend variables of interest rate can be represented by changes in treasury bond rate of 3 months; The short-term liquidity trend variables indicate short-term liquidity tightening degree of the financial market, which is represented by the difference of the interbank interest rate of 3 months and treasury bond rate of 3 months; The CSI 300 index yield represents market returns; US yield curve represents changes in world business cycle is expressed by the difference of US treasury bond interest of 10 years and 3 months; The Chinese yield curve represents the changes in the Chinese business cycle is expressed by the difference of Chinese treasury bond interest of 10 years and 3 months.

Table 2: Descriptive statistics of yield data

statistics	diversified finance	Bank	securities	insurance	real estate	financial system
mean	0.0463	0.0238	0.0213	-0.0069	0.0417	0.0254
max	11.0125	9.5507	15.5909	12.8579	9.3925	9.5044
min	-11.6225	-12.4412	-17.3323	-20.2730	-14.5848	-13.2688
std	2.6499	2.1106	2.9831	2.5398	2.4280	2.0626
skewness	-0.5158	-0.1090	-0.1194	-0.1712	-0.4973	-0.2556
kurtosis	5.3976	7.0075	5.9167	7.0374	5.3508	6.8914
JB-test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ADF-test	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

3.2 Systematic risk contribution of various financial industries

In order to measure the contribution of China's financial industry to the risk of the financial system as a whole, and investigate whether China's financial sector is asymmetric with the risk spillover of the financial system, this paper first calculates the contribution of individual financial industry to the whole financial systemic risk, and based on this, it measures the influence on the whole financial system when all financial sectors are at high risk;

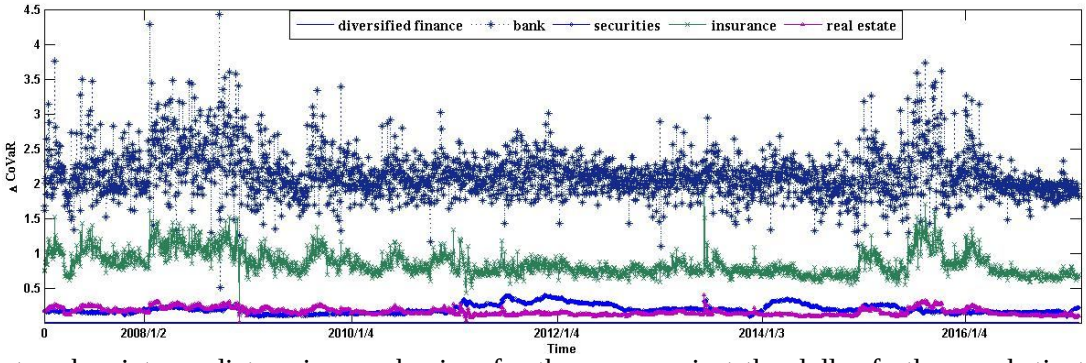
Considering the time and space dimension of systemic risk, according to formula (3)-(7), this paper calculates the dynamic, and answers which Chinese financial industry is the largest contributor to risk in the financial system. Table 3 shows the contribution of banking, real estate, securities, insurance and diversified finance to the systemic risk of the entire financial system, with the static in the first line, and the dynamic average value in the second line. The static shows that the contribution of China's financial industry to systemic risk is positively correlated with the size of the financial industry, except for diversified finance. Similar to many domestic empirical results, the dynamic results show that the scale factors of China's financial industry can be fully captured, and the contribution of Bank of China to the financial systemic risk is the largest, namely, the biggest risk for China's financial system comes from China's banking with large scale, and the contribution of diversified finance to the risk of the financial system is the smallest, but the risk spillover of China's insurance industry to the financial system is greater than real estate and securities industry whose distribution scale is larger, which is related with mixed management and business characteristics in the insurance industry.

Table 3:Contribution of financial industries to systemic risk of financial system

Measurement	bank	real estate	securities	insurance	diversified finance
Static mean ΔCoVaR	5.6911	5.4071	4.8857	4.8627	4.9477
Dynamic mean ΔCoVaR	2.1309	0.1593	0.1945	0.8536	0.0026

Figure 1 describes the contribution to systemic risk of China's entire financial system when the financial sub-sectors are at high risk in the sample range. Figure 1 reflects the time varying on the contribution of China's financial sub-sectors to the whole financial system, in which the change trend of the systematic contribution of banking, insurance, real estate and diversified finance to China's financial system is similar, and the only contribution of the securities industry to the financial system shows the special trend. Among them, during the global financial crisis in 2007-2009, the contribution of China's banking, insurance, real estate and diversified finance to the financial system is generally greater than its corresponding sample's average value; especially at the end of 2008, the risks faced by the financial industry during the financial crisis is larger, and its risk spillover to the system is greater. When the financial crisis was relieved, the contribution of various financial sectors to the risk of the financial system declined, and until 2009 when the European debt crisis broke out, the contribution of various financial sectors to the risk of the financial system increased, but the amplitude and duration were less than that during the financial crisis. In 2015, a few influential events happened in China's financial market. Since June 15, 2015, affected by the CSRC inventory distribution, China's stock market had begun to slump, and in just three weeks, the Shanghai composite index, Shenzhen component index and the gem index fell by 34.9%, 40.4% and 40.4% respectively, and the event that the stock market continued to slump is called a "crash". On August 11, 2015. People's bank of China announced that the RMB exchange rate no longer pegged to US dollar, but several kinds of major currencies, and then took market supply and demand as basis, with reference to a basket of currencies to calculate the change of the multilateral exchange rate index.

Figure 1 Systematic contribution of risk to financial industries



This adjustment makes intermediate price mechanism for the yuan against the dollar further marketization. On November 30, 2015, the IMF board approved the review report of the SDR, and concluded that RMB has already met the export and "freely usable" standard, so it decided to include RMB in the SDR currency basket, and the SDR basket correspondingly expands to 5 kinds of currencies including US dollar, euro, Japanese yen, pound;

It announced new SDR basket took effect on October 1, 2016. In 2015, China's stock market, currency markets faced greater risk, and the interpretation of the dynamic VaR variables includes China's exchange rate, interest rate and stock market information. During "crash" and "revaluation", China's banking, insurance, real estate and diversified financial stocks were affected a lot, so, the risk spillover to financial system increased during this period. However, due to the characteristics of China's securities industry, the change trend of the contribution of China's securities industry to the financial system risk is different from that of other industries.

3.3 Systematic risk-taking of various financial industries

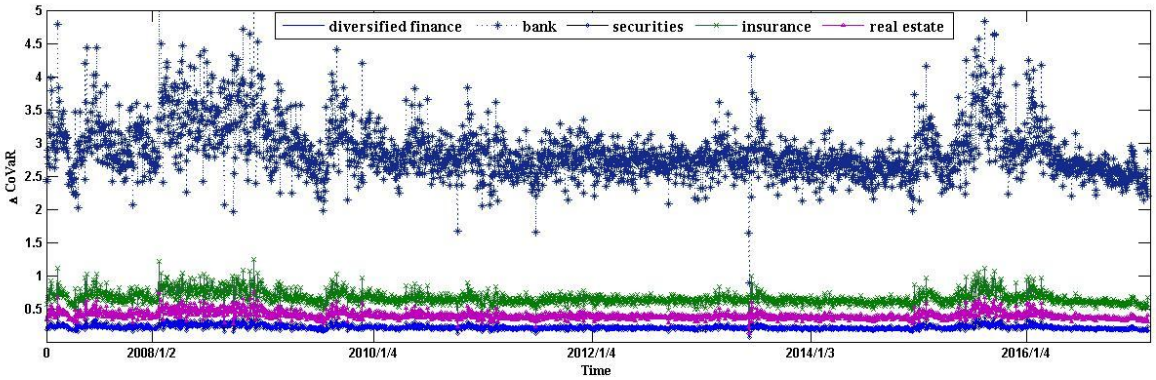
Table 4 shows the systemic risk bearing of each industry when the whole financial system is at high risk, and answers which financial industry in China undertakes the most systematic risk. Results show that the influence on bank is the greatest when China's financial system as a whole suffers the risk, followed by the insurance industry, the real estate industry, the securities industry and the diversified finance industry; the order is roughly in accordance with the circulation size of various financial industries, and the impact on traditional financial industry is greater than emerging financial industries, which is because the traditional financial industry has been closely linked with the financial system, and emerging financial industry does not penetrate deeply compared with traditional financial industry in terms of either size or business; in addition, the correlation is not strong, so the emerging financial industry is weakly affected by the financial systemic risk. However, Table 3 and Table 4 show the risk contribution of the insurance industry to the financial system is greater than the real estate industry and the securities industry with larger scale, and the insurance industry is greater affected by the financial systemic risk than the real estate industry and the securities industry. So, no matter from the financial industry, or the whole financial system, China's banking sector is the biggest risk source, followed by insurance industry, and the contribution of China's diversified financial industry to systemic risk and its influence of systemic risk is the weakest in the financial industry. From the contribution of individual financial industry to the whole financial system, the contribution of China's real estate industry to the systemic financial risk is less than the contribution of China's securities industry to the systemic financial risk, and from the influence on the risk value of various financial sectors exposed at risk when the overall financial system is in a state of high risk, systemic risk's influence on the real estate industry is greater than its impact on the securities industry.

Table 4:Systemic risk-taking in the financial industries

Measurement	bank	real estate	securities	insurance	diversified finance
Static mean $\Delta CoVaR$	6.4315	5.0848	5.6067	5.6346	5.3290
Dynamic mean $\Delta CoVaR$	2.8752	0.4011	0.2221	0.6641	0.2132

Figure 2 describes the time-varying diagram on the impact on various financial industries in China in the sample interval when the Chinese financial system is in a state of high risk. As shown in figure, China's financial systemic risk has the biggest impact on China's banking sector, followed by insurance, real estate, securities and diversified finance; during the financial crisis, the impact on China's financial sectors is not less than the average value of the sample. With the spread of financial crisis, the financial systemic risk declines, and the impact on the financial sector is also slow. On June 20, 2013, the overnight repo rate of Bank of China unprecedentedly reached 30%, and 7-day repo rate reached 28%, which is compared to "bank loan sharking" in the industry, called "money shortage". As shown in figure 2, during "money shortage", China's banking sector suffered very big impact; combined with figure 1, it is found "money shortage" has a huge impact on the banking sector, but the time was very short, and the contribution to the risk of the financial system was also increased. In the period of "crash" and "revaluation", China's financial system had greater impact on the financial sectors, and the impact on the banking sector was similar to that during the financial crisis, which is related to the Chinese stock market volatility in 2015.

Figure 2 systemic risk exposure in the financial industries



In conclusion, this paper measures the important of China's financial industry system from the two aspects, and weights the results obtained from the two aspects to get the sequence in the importance China's financial industry system as follows: banking, insurance, real estate, securities and diversified finance, which is similar to the sequence in the scale of various industries, and only the position of the insurance industry is more important than its scale. There is asymmetry in the risk spillover between China's financial sector and the financial system, especially the risk spillover of diversified finance to financial system is significantly less than the risk spillover of the financial industry to diversified finance.

3.4 Systematic risk spillover between industrial industries

In order to further analyze the importance of China's financial industry system and the risk spillover between the financial industries, this paper measures the dynamic systemic risk spillover between various financial sectors, but due to the limited space, there is no the time-varying figure to show the risk spillover between the financial sectors. Table 5 shows the dynamic risk spillover between the financial sectors, reflecting there is evident risk spillover between China's financial industries, and the risk spillover of different financial sectors have different intensity, and presents the obvious asymmetry.

The systemic risk spillover of diversified finance to securities is 1.1382, significantly greater than the systemic risk spillover of securities to diversified finance, which is 0.4695; the systemic risk spillover of diversified finance to insurance is 0.5769, significantly greater than he systemic risk spillover of insurance to diversified finance, which is 0.1161; the systemic risk spillover of diversified finance to real estate is 0.3182, greater than the systemic risk spillover of real estate to diversified finance, which is 0.3021; only the systemic risk spillover of diversified finance to banking is 0.2161, significantly less than the systemic risk spillover of banking to diversified finance, which is 0.6047. So, in addition that the systemic risk spillover of banking to diversified finance is greater than the systemic risk spillover of diversified finance to banking, and the risk spillover of other financial industries to diversified finance is less than the risk spillover of diversified finance to other financial industries, suggesting that the diversified finance in China has greater spillover intensity to other financial industries; due to and its smaller scale, it ranks lower in the financial system in terms of importance.

The systemic risk spillover of securities to banking is 0.1234, less than the systemic risk spillover of banking to securities, which is 0.3272; the systemic risk spillover of securities to real estate is 0.3821, less than he systemic risk spillover of real estate to securities, which is 0.4820; the systemic risk spillover of securities to diversified finance is 0.4695, less than the systemic risk spillover of diversified finance to securities, which is 1.1382. So in addition that bidirectional risk spillover between insurance and securities is similar, the risk spillover of other financial industries in China to securities is greater than the risk spillover of securities to other financial industries in China, which reflects the Chinese securities industry has relatively low risk spillover, and when it is reflected in the financial system, the risk spillover of securities industry to the financial system is less than the risk spillover of the financial system to the securities industry, which is consistent with the report in table 3-4, so the importance of China's securities in the financial system ranks behind its scale.

The systemic risk spillover of insurance to banking is 0.7596, greater than the systemic risk spillover of banking to insurance, which is 0.4055; the systemic risk spillover of insurance to real estate is 0.2952, greater than he systemic risk spillover of real estate to insurance, which is 0.1937; the systemic risk spillover of insurance to securities is less than the systemic risk spillover of securities to insurance.

So, in addition that the risk spillover of the diversified finance to insurance is significantly greater than the risk spillover of insurance to diversified finance, bidirectional risk spillover between insurance and securities is similar, the risk spillover of other financial industries in China to insurance is less than the risk spillover of insurance to other financial industries in China, which reflects the whole financial system, the risk spillover of insurance to the financial system is 0.8536, greater than the risk spillover of the financial system to the insurance industry, 0.6641, which shows the relatively higher risk spillover of Chinese insurance industry makes it rank higher in the financial system important than its scale.

The systemic risk spillover of real state to banking is 0.4300, greater than the systemic risk spillover of banking to real estate, which is 0.1372; the systemic risk spillover of real estate to securities is 0.4820, greater than he systemic risk spillover of securities to real estate, which is 0.3821; the systemic risk spillover of real estate to diversified finance is 0.3021, slightly less than the systemic risk spillover of diversified finance to real estate, which is 0.3182; the systemic risk spillover of real estate to insurance with evident characteristics of spillover is 0.1937, less than the systemic risk spillover of insurance to real estate, which is 0.2952. So, in addition to diversified finance and insurance with evident characteristics of spillover, the risk spillover of other financial industries to real estate is less than the risk spillover of real estate to others.

In the risk spillover of banking to other financial industries, only the risk spillover of diversified finance is 0.6047, significantly greater that the risk spillover of diversified finance to banking, which is 0.2161; the systemic risk spillover of banking to securities is 0.3272, greater than he systemic risk spillover of securities to banking, which is 0.1234; the systemic risk spillover of banking to real estate and insurance is 0.1372, 0.4055, less than the systemic risk spillover of real estate and insurance to banking, which is 0.4300, 0.7596; the share capital of the banking sector accounts for 74.33% of the Chinese financial system. So, while the risk spillover of banking to the real estate industry and insurance industry is less than the risk spillover of real estate industry to bank, the contribution of financial system is still the biggest, and suffers the most serious influence of the financial system, so the banking sector is undoubtedly the most important industry of China's financial industry.

Table 5: Dynamic mean value of systematic risk spillover among financial industries

dynamic $\Delta CoVaR$	$\rightarrow$ bank	$\rightarrow$ real estate	$\rightarrow$ securities	$\rightarrow$ insurance	$\rightarrow$ diversified finance
bank $\rightarrow$	--	0.1372	0.3272	0.4055	0.6047
real estate $\rightarrow$	0.4300	--	0.4820	0.1937	0.3021
securities $\rightarrow$	0.1234	0.3821	--	0.5935	0.4695
insurance $\rightarrow$	0.7596	0.2952	0.5577	--	0.1161
diversified finance $\rightarrow$	0.2161	0.3182	1.1382	0.5769	--

Note: The "$\rightarrow$"represents the direction of risk spillover. For example, the systematic risk spillover from bank to real estate is 0.1372, and the systematic risk spillover from real estate to banking industry is 0.4300.

4. Conclusion

This paper measures the systemic risk contribution of China's financial industry and systemic risk bearing, and the empirical results show that the systemic risk contribution of financial industry is not consistent with the risk, in which the systemic risk contribution of financial industry is sequenced as follows: banking, insurance, securities, real estate, diversified finance; the rank of systemic risk bearing is: banking, insurance, real estate, financial securities, and diversified finance; during the financial crisis, and during the period of "crash", the risk contribution of financial institutions in China to the risk of the financial system and the impact of financial system on the financial industry are significantly greater than the sample mean, especially during the financial crisis, with average value of time-varying sequence from two angles, the most important in China's financial system is banking industry, followed by insurance, real estate, securities and diversified finance, generally reflecting the scale of China's financial industry; in addition to system order of insurance industry prior to its scale sequence, insurance industry can partly reflect the public's confidence in the market, so the financial sector spillover is greater.

In order to further analyze the importance of China's financial industry system and the spillover between the financial industries, this paper continues to study the risk spillover of China's financial industries, and the results show that the risk spillover of diversified financial industry in China for other industries is greater than the risk bearing corresponded by the risk spillover of other financial sectors for diversified finance, in addition that the risk spillover of banking for diversified finance; China's insurance industry has strong risk spillover to other industries, and the risk spillover of insurance industry to other financial industries is greater than the corresponding risk bearing, in addition that the risk spillover of the insurance industry to the is less than the risk spillover of diversified finance to other financial industry; the risk spillover of China's securities industry for other financial industries is small, and only the risk spillover between insurance and securities is very close, the risk spillover of the remained financial industries for securities is greater than the risk spillover of the securities industry for financial industry, securities industry has weaker risk spillover to other financial industries; the risk spillover of China's real estate industry for banking and securities industry is greater than that for the real estate industry, and the risk spillover of the real estate industry for diversified financial industry and insurance industry is less than that for real estate industry, the strength for the risk spillover of the real estate industry is between diversified finance and insurance industry. In short, the risk spillover of China's diversified finance and insurance to other financial industries is relatively strong, and the risk spillover of diversified financial and insurance to other financial industries is almost all greater than the risk spillover of other financial industries. The risk spillover of securities industry to other financial industries is almost smaller than that of other financial industries to securities industry. However, for China's banking industry, due to the large scale, although its spillover characteristics to the financial industry is not consistent, it is the largest contribution to the marginal system risk industry in China, and the one suffering the most in China's financial system risk industry.

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