

Analysis on the Influencing Factors of Systemic Financial Risk of Chinese Commercial Banks Based on VAR Model

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Abstract—With the development of economic globalization, since the impact of the epidemic in 2020, financial issues have become the focus of more and more scholars at home and abroad. In order to study the financial risks of commercial banks and provide suggestions with reference significance for the economic recovery and financial development of countries under the impact of the epidemic, this paper based on the VAR model, selected from the China Banking and Insurance Regulatory Commission from the first quarter of 2013 to the fourth quarter of 2020 commercial banks' capital adequacy ratio, non-performing loan ratio, liquidity ratio and net interest margin several indicators, through the Eviews software to study the systemic financial risks of commercial banks, the research found that, capital adequacy ratio is obviously related to non-performing loan ratio, liquidity ratio and net interest margin, so it is suggested to reduce systemic risk of banks by strengthening financial supervision.

Keywords—Systematic financial risk; VAR; capital adequacy ratio.

I. INTRODUCTION

At the beginning of 2020, COVID-19 broke out in succession and spread rapidly on a large scale around the world, causing global panic and short-term stagnation of various production activities, resulting in a decline in the overall economy and fluctuations in the global financial market (Lan Bo and Zhuang Lei, 2021). In order to stabilize the volatility of the financial market and promote economic recovery, various governments have introduced a number of measures to deal with it. By the first half of 2021, China's economy will enter the turning point of recovery with the promotion of normal epidemic prevention and control and vaccination, which will provide a good external environment for the repair of global banking business performance and asset quality. However, it is difficult for the central banks of all countries to withdraw their loose monetary policies in the short term. The global low interest rate environment will continue, and the net interest margin of the global banking industry still faces great challenges. Therefore, this paper studies the influencing factors of financial risks of Chinese commercial banks based on VAR model, in order to provide some enlightenment for the systemic risk prevention and control of financial institutions in the future.

II. LITERATURE REVIEW

A. Definition of Systemic Financial Risk

The concept of systemic risk was initially associated with bank runs and currency crises. Since the outbreak of the global financial crisis in 2008, the international economy has been severely shaken, and systemic financial risk has once again attracted extensive attention from the international community (Yin Hao, 2020). The target of systemic risk is not limited to a single institution or market, but the whole or an important part of the entire financial system (He Qing et al, 2018). In a speech at Cambridge University in December 2009, Jean-Claude

Trichet, former president of the European Central Bank, defined systemic risk as "the risk that widespread instability in the financial system transforms into adverse effects on overall economic growth and welfare". De Bandt and Hartmann attributed systemic financial risk to the risk that the occurrence of a trigger event will lead to the bankruptcy of multiple financial institutions or even the collapse of the financial system (DE BANDT O and HARTMANN P, 2000).

To sum up, financial systemic risk refers to the fact that the failure of one or several important financial institutions will lead to the failure of other financial institutions through the interconnection of financial institutions, and thus produce substantial negative effects on the broader economy. Financial systemic risk may also lead to mass unemployment, social panic and turmoil, with economic and political connotations.

B. The Cause of Systemic Financial Risk

The causes of systemic risk present diversified characteristics. Kaufman(1999) believes that under the macro industry background of increasing financial vulnerability and accumulating potential financial risks, the occurrence of a trigger event will directly cause systemic financial risks. Jiang Shuxia et al.'s model(2006) elaborated the influence of credit concentration and expansion and soft budget constraint competition on the systemic risk of banks. Acharya (2009) believes that asset convergence of financial institutions is an important cause of systemic financial risks. Helmut's (2010) point of view is that improper regulatory policies and inadequate supervision are important reasons for the occurrence of systemic financial risks. Billio et al.'s study (2012) argued that strong interconnectedness among financial institutions induced systemic financial risks. The empirical study of Guo Ye et al (2017) shows that the expansion of shadow banking may trigger systemic risks. Fang Lei et al. (2017) believe that the homogeneity of financial behaviors of various financial institutions in the industry and the similarity of financial risks

constitute indirect causes of systemic financial risks. Li Shouwei et al. (2019) verified the spillover effect of banking multi-layer network structure on systemic risk by analyzing the data of 16 listed banks. The research of Zhang Xiaofei et al. (2020) shows that financial derivatives, including foreign exchange and interest rate financial derivatives, will aggravate the systemic risk of banks. The research results of Zhang Yu and Zhu Yihao (2020) show that financial openness and housing price regulation have different degrees of influence on systemic financial risks.

C. Study on Measurement and Early Warning of Systemic Financial Risk

China's financial market started late, and laws and market supervision mechanisms need to be improved, which makes China's financial market relatively unstable, and listed companies have higher extreme financial market risks (Cheng Weichao and He Jie, 2021).

Based on the dynamic CoVaR model, Gao Guohua et al. (2011) calculated the contribution of systemic risk and its influencing factors of 14 listed commercial banks in China with stock price data. Ren Biyun et al. (2015) established China's systemic financial risk early-warning indicator system based on AHP-DEA model to verify the efficiency of the early-warning indicator system of systemic financial risk. Li Zheng et al. (2019) found that systemic financial risk has significant risk spillover effect in China's financial industry by constructing the downward and upward Δ CoES measure and early warning system.

D. The Application of VAR Model in Systemic Financial Risk

Yang Zihui et al. (2019) tested the extreme risk contagion of China's banking, securities, insurance and real estate sectors through the vector autoregressivity model based on mixing, and found that there were significant nonlinear risk contagion effects among China's financial sectors. By constructing a Granger causality tail risk network, Pang Nianwei (2021) investigated the spatial structure and timely variation characteristics of China's systemic financial risks from the perspective of overall network relevance. Based on the perspective of generalized VAR correlation network, Zhao Hailin et al. (2021) decomposed and explored the static and dynamic characteristics of systemic financial risk spillover effect among various sectors of the financial sector by using the risk spillover index method in the financial market. Wang Yewen et al. (2021) used VAR model to analyze the relationship between shadow banking, financial leverage ratio and financial stability, and used threshold model to verify the relationship between financial leverage ratio and financial stability.

To sum up, the application of VAR model in systemic financial risks is very mature and has a wide range of application. However, there are few studies on financial risks of commercial banks based on VAR model. Therefore, this paper adopts VAR model to conduct relevant research on financial risks of Chinese commercial banks.

III. MODEL CONSTRUCTION AND EMPIRICAL RESULTS

A. Index Selection

Capital adequacy ratio is the ratio of a bank's total capital to its risk-weighted assets. Capital adequacy ratio is the embodiment of credit risk, operational risk and market risk (Zi Yanfang, 2020). Capital adequacy ratio is one of the most important indicators in the management assessment of commercial banks by the regulatory authorities, and also an important supporting mechanism for banks to resist risks (Liang Si, 2014). In the case of incomplete information and incomplete capital market, capital adequacy ratio has an impact on bank credit (Liu Bin, 2005). The capital adequacy ratio of commercial banks is affected by many factors, including their own profitability, asset structure and scale, and the amount of non-performing loans (Liang Si, 2014). The non-performing loan ratio refers to the proportion of the non-performing loans in the total loan balance of a financial institution. The higher the non-performing loan amount is, the worse the quality of the bank's assets will be and the greater the risk it will face. The non-performing loan can be used to measure the operational risk of the banking industry. Liquidity ratio refers to the ratio of current assets to current liabilities, reflecting the asset structure of a bank. The higher the ratio, the lower the liquidity risk of a commercial bank. Profit distribution is an important way for banks to increase their capital. The more profits a bank makes, the more profits it can distribute to supplement its capital (Zhong Yonghong, 2014). The improvement of the bank's net profit level can improve the bank's capital adequacy ratio, and a higher profit level can promote the improvement of its capital level. In this paper, the ratio of the bank's net interest income to all interest-bearing assets is used to represent the bank's profit level. Therefore, this paper selects capital adequacy ratio (CAR) as an important indicator to measure financial risks. The factors that affect capital adequacy ratio are as follows: non-performing loan ratio (BLR), liquidity ratio (CR) and net interest margin (NIM) of financial institutions. The index system of systematic financial risk evaluation and influencing factors is shown in Table I.

TABLE I. Commercial bank systematic financial risk evaluation and influence factor index system.

The evaluation index	Symbol	Influencing factor index	Symbol	Source
Capital adequacy ratio	CAR	Non-performing loan ratio of financial institutions	BLR	China Banking and Insurance Regulatory Commission
		Liquidity ratio	CR	
		Net interest margin	NIM	

These data are all from the China Banking and Insurance Regulatory Commission. As the data before 2013 is incomplete, this paper selects the data from the first quarter of 2013 to the fourth quarter of 2020 and uses Eviews software for analysis. In order to verify that this set of data is stable, VAR model can be used. First, an ADF unit root test was done, and then the data were used to test the optimal lag order of VAR model, and the

optimal lag order was determined to be 4. Then, the Granger causality test and the stability test of the model were completed. Finally, the impulse response analysis diagram and the result of variance decomposition were generated.

B. Model Building

Firstly, in order to eliminate the dimension of the data, and at the same time, since the logarithm function is monotonically increasing in its definition domain, it will not affect the relative relationship between the original data, this paper does a logarithm processing for the data. Since the establishment of regression model for non-stationary time series data is likely to produce "pseudo-regression", this paper conducted ADF unit root test for the stationarity of the four groups of data respectively, and the results showed that the P values of lnCAR, lnBLR, lnCR and lnNIM were all less than 0.05, so these groups of data were all stable. You can use the VAR model directly.

Before building the VAR model, it is necessary to select the optimal lag order. The optimal lag order obtained by Eviews can be determined to be 4. Then according to equation (1), the results of VAR model are shown in Table II.

$$Y_t = \mu + A_1 Y_{t-1} + \dots + A_p Y_{t-p} + \varepsilon_t \quad (1)$$

$t = 1, 2, \dots, T$

Granger causality test for time series showed that the response P values of lnBLR, lnCR and lnNIM to lnCAR were all less than 0.05, rejecting the null hypothesis, indicating that lnBLR, lnCR and lnNIM were all the causes of lnCAR, that is, the model was significant as a whole.

After the above analysis, in order to judge the stability of the VAR model, the robustness test was carried out on the estimated results of the VAR model, as shown in Fig. 1. Fig. 1 shows that all the characteristic roots are in the unit circle, and it can be seen from the data that the root modules are all less than 1, so the constructed VAR model is stable and the estimated results are valid.

Fig. 2 shows the response trend of lnBLR to various variables from impulse response analysis results. As can be seen from the figure, lnBLR was 0 in phase 1 when given a shock, and then stabilized after reaching the peak value in phase 4 and 7 respectively. Then, a shock was given to lnCR. LnBLR reached the lowest point in the second phase, and then rose slowly, and became stable after reaching the highest point in the sixth phase. Finally, lnNIM had a shock. LnBLR fluctuated up and down at first and then stabilized.

According to the analysis of the above model results, the following conclusions can be drawn: capital adequacy ratio is significantly correlated with non-performing loan ratio, liquidity ratio and net interest margin; Non-performing loan ratio has a stronger reaction to the capital adequacy ratio and a high contribution rate, which is negatively correlated with the two, while liquidity ratio and net interest margin are positively correlated with the capital adequacy ratio, and the explanation for the capital adequacy ratio is at a low level. Financial supervision of commercial banks can reduce financial risks by reducing non-performing loan ratio, improving capital adequacy ratio, liquidity ratio and net interest margin. There is a negative correlation between capital adequacy ratio and non-

performing loan ratio, that is, sufficient capital supply can effectively reduce the non-performing loan ratio of financial institutions, and further reduce the financial risk of commercial banks. Therefore, the government can increase support, optimize the rational allocation of financial resources, ensure that commercial banks have sufficient capital to resist financial risks, and stimulate economic growth.

TABLE II. VAR model lags 4 order results.

	LnBLR	LnCAR	LnCR	LnNIM
LnBLR(-1)	0.927053	-0.016173	-0.343712	-0.138273
LnBLR(-2)	-0.10028	0.399572	0.253684	0.206938
LnBLR(-3)	-0.254433	-0.43239	-0.140411	-0.064362
LnBLR(-4)	0.02458	0.183608	-0.040744	-0.265244
LnCAR(-1)	1.064312	0.513695	0.664627	0.708819
LnCAR(-2)	1.451051	-0.763993	-0.377935	-1.226412
LnCAR(-3)	0.225331	0.53563	0.604692	2.180667
LnCAR(-4)	-0.330022	-0.374048	1.23034	-0.967131
LnCR(-1)	-0.218125	0.272506	0.171559	0.40756
LnCR(-2)	-0.198409	0.092179	0.353988	-0.046468
LnCR(-3)	-0.191071	0.094269	-0.155369	-0.337184
LnCR(-4)	-0.36867	-0.037659	-0.383202	-0.242223
LnNIM(-1)	0.144153	0.266678	-0.042912	0.693168
LnNIM(-2)	-0.564375	-0.138956	0.401853	-0.210128
LnNIM(-3)	0.009238	-0.092952	-0.071584	-0.168709
LnNIM(-4)	0.213681	0.078525	-0.574172	0.17004
C	1.755569	-0.905822	1.393658	-1.819106

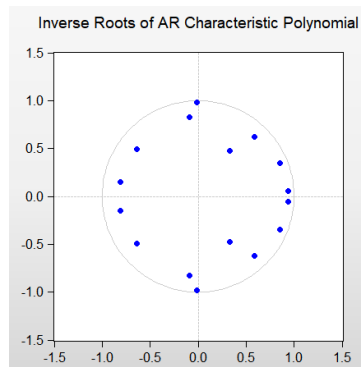


Fig. 1. Model stability analysis diagram.

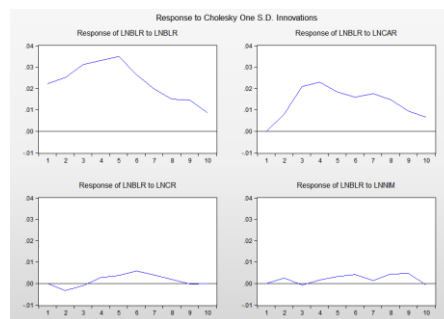


Fig. 2. Pulse response analysis diagram.

IV. POLICIES AND RECOMMENDATIONS

A. Strengthen Prevention of Financial Risks

Preventing and defusing financial risks, especially systemic financial risks, is the fundamental task of financial work. It is necessary to speed up the construction of financial market infrastructure centering on building a comprehensive and multi-level financial support and service system for a modernized

economy. We should do a good job in comprehensive statistics of the financial industry, establish and improve information systems that reflect risk fluctuations, improve information release management rules and improve credit punishment mechanisms. Modern scientific and technological means should be used to dynamically monitor the flow of capital, both online and offline as well as at home and abroad, so that all capital flows are under the supervision of financial regulators.

B. Strengthen Financial Supervision and Regulation

Effective financial supervision is an early regulatory intervention that can timely and accurately judge the risk exposure of financial institutions and the possibility of causing systemic financial risks before the occurrence of systemic financial risks. In addition to establishing a sound financial supervision system, financial supervision institutions also involve various fields such as economy, law, finance and taxation, and also need high-level talents related to financial supervision. Financial supervision needs to strengthen the supervision of capital adequacy ratio and non-performing assets, restrain the generation of non-performing assets and encourage commercial banks to strengthen risk control.

C. Improve Risk Early Warning and Asset Evaluation Systems

China's banking industry has accumulated many potential risks in the rapid expansion of asset scale and profit level in recent years. Changes in domestic and foreign economic situation and market environment bring more uncertain factors to the sound operation of commercial banks. Therefore, it is necessary to establish a more systematic risk early-warning mechanism to prevent the risks of the banking industry scientifically while restricting the operation of commercial banks. In addition, the asset structure and quality of commercial banks should be assessed regularly, and capital stress tests should be conducted to master the capital situation of commercial banks and make forward-looking judgments to prevent in advance.

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