

Empirical Analysis of the Impact of Chinese Commercial Banks on Financial Market Risk Based on the CoVaR Method

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Abstract: The paper conducts an empirical analysis using the CoVaR model and data sourced from weekly individual stock returns of listed Chinese commercial banks to examine the impact of individual commercial banks on the entire financial system. Overall, the stock price risk of Chinese commercial banks exhibits a negative spillover effect on the financial market. Based on dCoVaR values from 2006 to 2023 and in conjunction with financial events related to the market over the 17-year period, it is evident that significant events lead to notable negative spillover effects by commercial banks' stock price risk on the entire financial system, highlighting their crucial influence on financial market risk.

Keywords: commercial banks, CoVaR, risk spillover

1. Introduction

Commercial banks play a vital role as financial intermediaries in a country's economic development through services such as deposits, loans, foreign exchange, and savings. In China, commercial banks have gradually expanded, with state-owned commercial banks dominating the sector. As of 2021, the number of Chinese commercial banks reached 4,608, showcasing significant growth. [1]

On March 8, 2023, Silicon Valley Bank (SVB), the 16th largest bank in the United States, announced its plan to divest its assets and issue stock financing. This announcement triggered a run on the bank, ultimately leading to SVB's bankruptcy. This incident marked the largest-scale collapse in the US banking industry since the 2008 financial crisis. The event had a significant impact on the US banking sector, with banks holding substantial positions in US government bonds facing the risk of runs due to a crisis of confidence. [2]

The bankruptcy of Silicon Valley Bank serves as a warning example. If a Chinese commercial bank were to experience a similar bankruptcy event or a major financial risk, what impact would it have on other Chinese commercial banks or the entire banking industry?

Hence, analyzing the spillover effects of an individual bank's stock price risk facing a financial crisis on other banks and the entire banking system becomes a crucial and worthy research topic. Among the various risk measurement methods used in financial institutions, Value at Risk (VaR) is commonly employed. However, measuring the risk of an individual bank may not fully reflect the stability risk threats to the banking industry as a whole.

The paper utilizes the CoVaR (Conditional Value at Risk) model for analyzing the risk in the entire banking industry. The CoVaR model was developed by Adrian and Brunnermeier in 2016. In the risk measurement of the CoVaR model, the prefix "Co" is added to the existing risk measurement, representing conditional, interconnected, contagious, or contributory aspects. The CoVaR of institution i is defined as the VaR of the entire system when institution i is in distress. The difference ΔCoVaR between the CoVaR conditioned on the distress of institution i and the CoVaR conditioned on its normal state captures the marginal contribution of an institution. Therefore, the paper employs the CoVaR model to analyze the Chinese banking industry and explore potential risk measurements for the future.

2. CoVaR Model

In order to analyze the spillover effects of individual banks' stock price risk on the entire financial system, the paper will employ the CoVaR model to conduct regression estimation on the Chinese banking market and subsequently utilize Chinese bank stock market data for regression forecasting. [3]

The general form of the VaR (Value at Risk) model is defined as the q -quantile:

$$\Pr(X^i \leq \text{VaR}_q^i) = q \quad (1)$$

Where X_i is the variable of institution i that defines VaR.

$\text{CoVaR}_{q|j|i}$ is defined as the VaR of financial institution j (or the entire financial system) under the occurrence of a certain event $C(X_i)$. In usual practice, institution j is regarded as the systemically important institution. Consequently, the general form of the CoVaR model can be expressed as:

$$\Pr(X^j \leq \text{CoVaR}_q^j | C(X^i)) = q \quad (2)$$

The contribution of institution i to institution j is represented as:

$$d\text{CoVaR}_q^j | i = \text{CoVaR}_q^j | X_i=\text{VaR}_q^i - \text{CoVaR}_q^j | X_i=\text{Median} \quad (3)$$

In the paper, we mainly focus on the scenario where institution j represents the entire financial system, i.e., when the returns of the investment portfolios of all financial institutions are at their VaR levels. In this case, we remove the superscript j . Thus, $d\text{CoVaR}_q^i$ represents the difference between the financial system VaR conditioned on the distress of a specific financial institution i and the financial system VaR conditioned on the median state of institution i . The general expression is:

$$d\text{CoVaR}_q^i = \text{CoVaR}_q^{X_i=\text{VaR}_q^i} - \text{CoVaR}_q^{X_i=\text{Median}} \quad (4)$$

3. Data

This article employs the weekly individual stock return series (variable X_i) of 38 Chinese listed commercial banks, including Bank of China, China Construction Bank, and Agricultural Bank of China, among others. The descriptive statistics of these selected commercial banks are presented in Table 1, along with their respective stock codes.

Table 1: Selected commercial banks and descriptive statistics.

Bank Code	Bank Name	Mean Return	Standard Deviation	Sharp Ratio
000001	Ping An Bank	0.004201845	0.057835	0.072652
001227	Lanzhou Bank	-0.010410258	0.06286	-0.16561
002142	Ningbo Bank	0.002321103	0.048924	0.047443
002807	Jiangyin Bank	0.001424023	0.064971	0.021918
002936	Zhengzhou Bank	-0.003314605	0.035027	-0.09463
002948	Qingdao Bank	-0.001650113	0.04213	-0.03917
002966	Suzhou Bank	-0.000593579	0.034364	-0.01727
600000	Shanghai Pudong Bank	0.003514843	0.049929	0.070396
600015	Huaxia Bank Huaxia Bank	0.002953033	0.047408	0.06229
600016	Minsheng Bank	0.002968369	0.043155	0.068784
600036	China Merchants Bank	0.004201451	0.047387	0.088662
600908	Wuxi Bank	0.001984121	0.063208	0.031391
600919	Jiangsu Bank	0.000022314	0.031354	0.000712
600926	Hangzhou Bank	0.001515929	0.041263	0.036738
600928	Xi'an Bank	-0.000355654	0.056125	-0.00634
601009	Nanjing Bank	0.002143091	0.043294	0.0495
601128	Changshu Bank	0.002545684	0.057916	0.043954
601166	Industrial Bank	0.002735047	0.050787	0.053853
601169	Bank of Beijing	0.000511237	0.059472	0.008596
601187	Xiamen Bank	-0.000581262	0.037744	-0.0154
601229	Shanghai Bank	-0.001030844	0.046054	-0.02238
601288	Agricultural Bank of China	0.001716209	0.025442	0.067457
601328	Bank of Communications	0.00071163	0.026325	0.027033
601398	Industrial and Commercial Bank of China	0.001971953	0.039377	0.050079
601528	Rui Feng Bank	-0.002630188	0.035232	-0.07465
601577	Changsha Bank	0.000031055	0.056925	0.000546
601658	Postal Savings Bank of China	0.00102054	0.036661	0.027837
601665	Qilu Bank	-0.002500309	0.08064	-0.03101
601818	China Everbright Bank	0.001395058	0.038826	0.035931
601838	Chengdu Bank	0.001972768	0.043581	0.045267
601860	Zijin Bank	-0.000368888	0.063507	-0.00581
601916	Zhejiang Commercial Bank	-0.001250876	0.023311	-0.05366
601939	China Construction Bank	0.001104124	0.035875	0.030777
601963	Chongqing Bank	-0.003923026	0.037834	-0.10369
601988	Bank of China	0.001614931	0.034148	0.047292
601997	Guiyang Bank	-0.000860759	0.0313	-0.0275
601998	CITIC Bank	0.00108434	0.044735	0.024239
603323	Sunong Bank	-0.000523538	0.043649	-0.01199

This study uses the comprehensive weekly market return series for the Shanghai and Shenzhen A-shares, ChiNext board, and STAR Market as market indices. The data sources are CSMAR and Wind databases, and the sample period ranges from the 1st week of 2006 to the 19th week of 2023.

4. Empirical Analysis

Based on the aforementioned data, the average dCoVaR for each Chinese listed commercial bank, from the 1st week of 2006 to the 19th week of 2023, is calculated and shown in Figure 1.

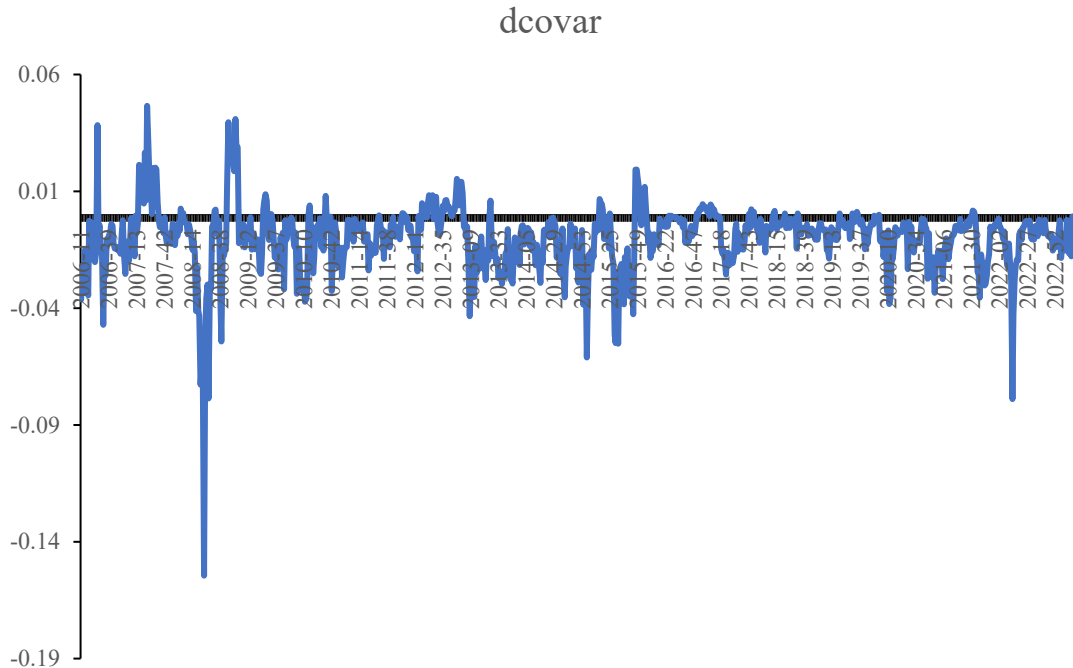


Figure 1: Average dCoVaR.

Since dCoVaR can represent the spillover effects of individual financial institutions' stock price risk on the entire financial system, the chart above represents the spillover effects of commercial banks' stock price risk as participants in the financial market on the entire Chinese financial system.

Firstly, in the vast majority of cases, commercial banks' stock price risk exhibits a negative spillover effects on the financial system, indicating that these financial entities significantly influence the overall financial risk of the Chinese financial market.

In 2008, due to the underestimated risk of financial derivatives such as MBS, investor distrust towards risk rating agencies led to a global subprime crisis. Following the 2008 financial crisis, the Chinese financial market experienced escalating liquidity crises. During this financial crisis, the role of commercial banks' stock price risk in the spillover effects on the Chinese financial market became evident. Before 2008, commercial banks' dCoVaR remained below -0.05. However, after the subprime crisis, the negative spillover effects of commercial banks' stock price risk on the financial system reached -0.15. This indicates that during the liquidity crisis caused by the instability of financial institution loans and financial derivatives, the negative impact of commercial banks on the financial system's risk significantly increased, underscoring their critical importance to the Chinese financial system.

Following the outbreak of the subprime crisis in 2008, China's economic growth rate rapidly declined. In response to the impact of the crisis, the Chinese government implemented ten measures to promote economic development, known as the "Four Trillion Yuan Plan."^[4] As seen in Figure 1, after 2008, the negative spillover effects of commercial banks' stock price risk on the financial system continuously weakened, stabilizing the financial market. After the stimulation from this plan, China's financial market experienced tightened macroeconomic controls and increased supervision of on-

balance sheet operations, leading to a rapid expansion of off-balance sheet operations by banks. This, in turn, triggered the "liquidity shortage" in June 2013, with the Shibor skyrocketing 578.4 basis points to 13.44%. After 2013, even positive spillover effects were observed, indicating that the rapid expansion of off-balance sheet operations and increasing leverage provided some support to the financial market, resulting in positive spillover effects on the entire financial system. By late June 2013, with stringent supervision by the central bank and a slowdown in off-balance sheet and interbank business growth for various local financing platforms and commercial banks, [5] financial institutions' liquidity improved, and the dCoVaR of commercial banks returned to the normal range of 0 to -0.05.

After 2020, China's economy faced significant challenges due to the impact of the COVID-19 pandemic, leading to a slowdown in the growth of the Chinese financial market. Against this backdrop, the spillover effects of Chinese commercial banks' stock price risk on the financial market became more apparent. As shown in Figure 1, after 2020, Chinese commercial banks' dCoVaR exhibited more pronounced fluctuations compared to the period between 2015 and 2019, with the peak reaching -0.04. This indicates that under the pressure of the pandemic, commercial banks played a core role in the financial market through their various business activities, and the pandemic significantly negatively affected the operations and performance of Chinese commercial banks, resulting in more evident negative spillover effects on the Chinese financial market. This demonstrates the crucial role of commercial banks in addressing significant shocks to the financial market.

In conclusion, commercial banks, as participants in the financial market, play a vital role in risk management for the financial system. Especially during major financial events such as the mentioned subprime crisis in the United States, the "liquidity shortage" in 2013, and the COVID-19 pandemic, the stock price risk of commercial banks usually exhibits significant negative spillover effects on the financial market. This is a result of various risk management strategies employed by commercial banks, such as risk compensation, which involves pricing compensation for the risks undertaken before substantial losses occur. The pivotal position of commercial banks in financial market risk control is evident, as banks can adequately consider multiple risk factors in pricing financial assets, leading to risk returns. With proper risk pricing, other market participants can then engage in risk asset transactions based on their risk preferences. Overall, the dCoVaR data in Figure 1 shows that Chinese commercial banks have a significant impact on financial market risk, playing a central role in the stable and orderly development of the Chinese financial market.

5. Conclusion

The primary focus of this study was to examine the spillover effects of Chinese commercial banks' stock price risk on the entire financial system during significant events that have a major impact on the financial market. To address this issue, the dCoVaR method was employed to calculate the spillover effects of commercial banks' stock price risk, which represents the difference between CoVaR when a specific event occurs and the risk-neutral CoVaR, indicating the magnitude of the spillover effect. The study utilized weekly individual stock returns of 38 Chinese listed commercial banks along with market indices to calculate the average dCoVaR. Analyzing the variations in dCoVaR during different periods and correlating them with major impactful events led to the conclusion that Chinese commercial banks have a significant and long-term influence on the systemic risk of the financial market. Particularly during major events, Chinese commercial banks tend to exhibit higher dCoVaR, signifying their crucial role in shaping the overall financial risk of the market. In summary, this study demonstrates that Chinese commercial banks play a critical role in the systemic risk of the financial market. Their impact is particularly evident during significant events, as indicated by the elevated dCoVaR values observed during such times. The findings highlight the

substantial influence of commercial banks on the financial market's risk and emphasize their essential role in shaping the stability and functioning of the entire financial system.

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