

# *The Use of ERM in Systemic Risk Analysis in Banking: Take Silicon Valley Bank's Bankruptcy as an Example*

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**Abstract:** The problem of systemic risk contagion within the banking industry has always been the trigger of major financial crises. The bankruptcy of Silicon Valley Bank in March 2023 has brought a huge systemic crisis to the world banking industry, making the analysis of systemic risk of banks a major issue to be solved urgently. The existing researches on risk contagion mechanism have limited explanatory ability. Therefore, this paper introduces the comprehensive risk management theory to analyze the core factors of systemic risk transmission among banks. By constructing the indicators of unrealized loss, risk expectation, maturity allocation and deposit stability in SVB and American banking industry, it is found that the lack of deposit stability is the core factor of systemic risk contagion caused by SVB bankruptcy in American banking industry. Therefore, this paper proposes that attention should be paid to the control of high-interest deposit-taking behavior of small and medium-sized banks in order to avoid operational risk, strengthen macro-policy guidance and optimize the structure of long-term deposit liabilities.

## 1. Introduction

For a long time, banks have been the core of the financial industry around the world, operating through indirect finance, and banks have occupied a decisive position in financing for a long time. But at the same time, the characteristic of high debt management in banking industry itself and the spread of systemic risk aggravate the impact of its potential bankruptcy risk. On March 10<sup>th</sup>, 2023, the bankruptcy of Silicon Valley Bank (SVB), which focuses on the financing business of start-up technology enterprises, once again aroused the attention of the global financial community to the systemic risk contagion of commercial bank bankruptcy. This paper attempts to introduce the theory of enterprise risk management (ERM), taking this incident as an example to analyze the systemic risk of banks.

The theoretical basis of comprehensive risk management is Enterprise Risk Management-Integrated Framework (COSO, 2004)<sup>[1]</sup> published by COSO in 2004. The document puts forward the idea of enterprise risk management combining internal control framework with risk management, which consists of internal environment, target setting, event identification, risk assessment, risk response, control activities, information and communication and monitoring.

With the further research on the application of COSO framework, comprehensive risk management has entered a stage of professional development. Some studies have improved the

adaptability of ERM framework in various industries, such as combining COSO framework with Basel system and establishing an effective internal control system for commercial banks (Liu Xiaolun, 2010)<sup>[2]</sup>. Commercial banks tend to be large in scale, and there is a possibility of hedging internal risks. Existing studies focus on a single silo-type risk management, which will lead to the waste of resources (Mukhtar Adam, 2021)<sup>[3]</sup>. Therefore, for the risk management of commercial banks, it is of great practical value to analyze and improve the internal control of banks in combination with the eight elements of COSO. (Jiao Liang, 2010)<sup>[4]</sup>.

At present, the research on systemic crisis of banking bankruptcy focuses on the analysis of contagion mechanism, such as two mainstream mechanisms called interbank debt default channel (Furfine, 2003)<sup>[5]</sup> and financing liquidity risk channel (Tressel, 2010)<sup>[6]</sup>, establishing models to analyze the impact of systemic risk. However, at present, the established contagion mechanism has limited ability to explain the systemic risk of bank bankruptcy (Fang Yi, 2016)<sup>[7]</sup>, and there is a lack of research on the contagion mechanism itself. The problem also exists in the study of systemic risk of banks in China (Ma Junlu, 2007)<sup>[8]</sup>.

Therefore, this paper introduces ERM framework to analyze the systemic risk of banks. In the second part, it introduces ERM theory system to analyze the key factors leading to the bankruptcy of SVB. In the third part, it selects the corresponding indicators according to the characteristics of the factors, analyzes the commonalities among the subsequent bankrupt banks and explores the core factors of the systemic risk contagion among banks. In the fourth part, the core factors are analyzed whether there are weaknesses in the current response measures of China's banking industry, and policy recommendations are put forward.

## **2. Analysis of SVB Bankruptcy Factors from ERM Perspective**

### **2.1. Internal Environment**

The internal environment encompasses the tone of the organisation, influences the risk awareness of people in the business, underpins the other elements of comprehensive risk management, and provides the constraints and structure for the other elements. The profitability of SVB itself shows that it has a more radical risk management concept and higher risk tolerance than other banks. SVB advocates making up for the high risk in operation through higher investment returns, and has suffered huge losses in the two financial crises.

### **2.2. Goal Setting**

Goal setting includes strategic objectives, business objectives, reporting objectives and compliance objectives. ERM is the guarantee for enterprises to achieve their goals, but the achievement of goals will also be affected by external uncontrollable events.

SVB's strategy and business objectives are based on a profit model with high risk and high income. With the basic problems of lacking effective risk monitoring system and high-risk operation caused by internal compensation and performance evaluation, the strategy and business objectives will inevitably lead to unexpected significant losses of SVB, and then result in serious financial difficulties.

In terms of reporting objectives, the current debt accounting standards of commercial banks have some shortcomings: the unrealized losses of bond assets have not been reduced, and the capital has not fully realized the function of financial reporting to report the current situation of enterprise operation. Moreover, the credit risk-weighted asset measurement method guided by the Basel regulatory system is regarded as risk-free assets for treasury bonds and mortgage-backed bonds, regardless of their duration, and the risk-weighted coefficient is 0. So the bond portfolio of SVB

does not appear in the denominator of the capital ratio. These two aspects give banks an incentive to solve the problem of insufficient loans by expanding bond investment.

In terms of compliance objectives, there is no need to set up a counter-cyclical capital buffer due to the requirement named the tiered regulation of the banking industry in the United States for the fourth-tier banks in Silicon Valley Bank, and they conduct their own capital stress tests every two years. Moreover, the deposit reserve system in the United States is loose, which means that banks can choose the amount of reserve themselves and the deposit reserve of SVB is almost 0%. Loose compliance target regulation gives commercial banks the motivation and feasible space to underestimate risk and save capital in risk assessment.

### 2.3. Event Identification and Risk Assessment

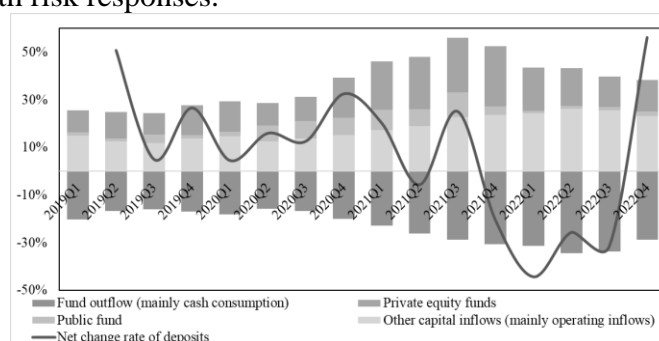
Events include internal and external enterprise events. Internal events include infrastructure, people, processes, and technology, while external events include economy, natural environment, politics, society and technology. In risk assessment, executives should consider expected and unexpected events, inherent risks and residual risks.

SVB’s bankruptcy is directly related to the Federal Reserve's rapid and substantial interest rate hike in 2022. Its management disclosed in its annual report in 2021 that the stress test simulated interest rate changing scenario, in which the maximum interest rate rise was 2%, and the bank's equity would fall by \$5.7 billion, but the interest rate actually rose by 4.5%. The amount of floating loss has even exceeded the total owner's equity of SVB. This shows that SVB has insufficient identification of interest risk and underestimation of risk when allocating assets.

Subject to compliance requirements, SVB was overly optimistic in its risk assessment and underpredicted the interest rate changing scenarios in its stress tests, which led to its failure to make adequate provisions to address the risk of interest rate changes, which in turn led to insolvency.

### 2.4. Risk Response and Control Activities

Risk response includes risk avoidance, risk reduction, risk sharing and risk tolerance. Control activities are the policies and procedures to ensure that risk responses are implemented, which should be integrated with risk responses.



Note: Data from Wind database and annual report of Silicon Valley Bank (SIVB).

Figure 1: Structure of Deposit Capital Flow of Silicon Valley Bank

The sharp reduce of interest made by The Federal Reserve, which began in March 2020, has also led to the rapid growth of loans and venture capital funds for technology start-ups. These companies have accumulated a large number of deposits, many of which are deposited in SVB, and the risk of SVB deposit management has risen. To this end, SVB's choice of risk response measures is to allocate a large number of held-to-maturity securities in 2021, which greatly reduces liquidity. However, as shown in Figure 1, the stability of deposits, as the most important component of SVB

liabilities, is very poor. SVB mainly absorbs deposits from science and technology enterprises. Since 2022, the cash consumption of science and technology enterprises has increased, resulting in a large loss of deposits and a large liquidity problem of deposits. Figure 1 analyzes the flow of Silicon Valley Bank's deposits from the first quarter of 2019 to the fourth quarter of 2022.

The failure of SVB's risk response and control measures exposes the common problems of bank bankruptcy: the lack of deposit stability and liquidity.

## 2.5. Internal Monitoring and Information Communication

Internal control is the assessment of the existence and operation of all ERM elements, which determines whether comprehensive risk management continues to be effective. Information communication requires that the construction of information must be flexible and agile enough to support business strategy and risk management.

SVB's internal corporate governance structure was flawed. For example, the company's chief risk officer ceased to perform his duties in April 2022, but the company did not disclose it until early March 2023. During this period, the risk committee did not have any effective supervision over the management, had no ability to challenge the management's decisions, and fail to achieve any effective information communication in the aspect of risk management.

To sum up, from the analysis of the above eight factors, there are four factors that are directly related to the bankruptcy of SVB and have a significant impact: the provision of unrealized investment losses in the reporting objectives, the underestimation of interest rate changes in risk assessment, the term mismatch in risk response, and the lack of deposit stability in control activities. Other issues such as internal environment, strategic operation, monitoring and communication are highly subjective, complex and difficult to cause significant impact in the short term, so they are not analyzed as a priority.

## 3. Analysis of Core Transmission Factors of SVB Bankruptcy

Table 1: US Banking Sample

Name of the Bank	Short Name	Scale	Rise and Fall (March 8 <sup>th</sup> – May 1 <sup>st</sup> )
First Citizens Bank	FCNCA	Small and medium-sized banks	49.36%
JPMorgan Chase	JPM	Large banks	2.47%
Citigroup	C	Large banks	-6.77%
Wells Fargo	WFC	Large banks	-7.87%
Bank of America	BAC	Large banks	-10.81%
Kulun Buddhist Temple Bank	CFR	Small and medium-sized banks	-15.28%
Regional Financial Corporation	RF	Small and medium-sized banks	-18.01%
Five-three Bank	FITB	Small and medium-sized banks	-23.36%
Huntington Bank	HBAN	Small and medium-sized banks	-23.89%
Citizens Financial Group	CFG	Small and medium-sized banks	-24.32%
Webster Financial Corporation	WBS	Small and medium-sized banks	-25.23%
US Bancorp	USB	Large banks	-27.59%
East West Bank Group Inc	EWBC	Small and medium-sized banks	-30.63%
Silicon Valley National Bank	VLY	Small and medium-sized banks	-30.66%
United Credit Bank	CMA	Small and medium-sized banks	-36.85%
Zion Bank	ZION	Small and medium-sized banks	-42.54%
The Bank of the West, Alaynes	WAL	Small and medium-sized banks	-49.08%
First Republic Bank	FRC	Small and medium-sized banks	-99.71%
Silicon Valley Bank Financial Group	SIVB	Small and medium-sized banks	-99.81%
Signature Bank/New York	SBNY	Small and medium-sized banks	-99.92%

Note: Data are from Wind database.

The bankruptcy of SVB has had a greater systemic risk impact on the banking industry in the United States, followed by the bankruptcy of Signature Bank and First Republic Bank. Moreover, with the bankruptcy of Credit Suisse, the systemic financial risk brought by the bankruptcy of Silicon Valley Bank has spread in European and American financial markets (Peng Wensheng, 2023)<sup>[9]</sup>. Starting from the above four issues, this paper will establish corresponding indicators to analyze the effect of distinguishing bankrupt banks from non-bankrupt banks, so as to obtain the core transmission factors of bankruptcy. To this end, this paper chooses 20 American commercial banks shown in Table 1 as a sample for analysis.

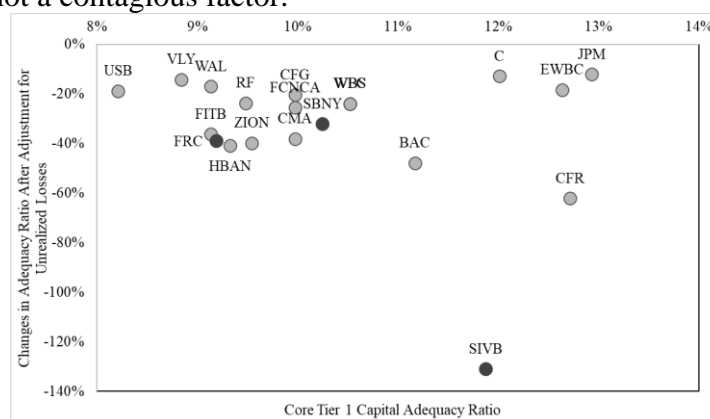
### 3.1. Reporting Objective: Index Selection and Comparison of Unrealized Loss Accrual

#### 3.1.1. Index Selection

For non-interest income earned by commercial banks engaged in financial investment business, the existing literature mainly applies the ratio of the size of investment assets like bonds to total assets as a measure of the risk of investment loss (Zhang Lin, 2020)<sup>[10]</sup>. On this basis, this paper adds the factor of unrealized losses, and uses the core tier-one capital adequacy ratio excluding unrealized losses as the analysis variable, considering not only the impact of unrealized losses, but also the adequacy of capital.

#### 3.1.2. Analysis of Indicators

As shown in Figure 2 below, taking the change rate of the core tier-one capital adequacy ratio of US commercial banks adjusted by unrealized losses relative to the original adequacy ratio as the vertical axis and the core tier-one capital adequacy ratio as the horizontal axis, the figure shows that the unaccrued losses of US banks have a greater impact on the capital adequacy ratio and the unaccrued losses of SVB are the most serious. There is no distinction between insolvent banks and non-insolvent banks, which only shows that non-accrual loss is one of the reasons for SVB's bankruptcy, but it is not a contagious factor.



Note: Data are from Wind database and annual reports of banks.

Figure 2: US Banking Before and After Adjustment for Unrealized Losses

### 3.2. Risk Assessment: Selection and Comparison of Indicators for Risk Underestimation

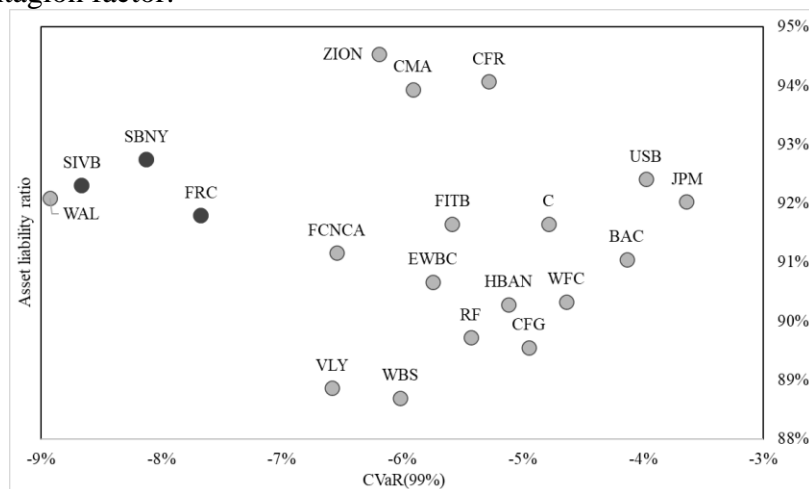
#### 3.2.1. Index Selection

For the measurement of the expected risk level in the risk assessment of commercial banks, the most direct and convenient indicator to obtain is the expected level of interest rate changes and

corresponding losses in stress testing, which has also been applied in research (Zhang Meng, 2016)<sup>[11]</sup>. However, the stress test scenario setting and disclosure caliber in the published statements of banks are inconsistent, which can not form an effective horizontal comparison. This paper argues that since the core of corporate management is to maximize shareholders' equity reflected directly by stock value, the management's risk expectation will be related to the maximum loss of stock price under a certain confidence level. Therefore, this paper calculates the CVaR value of the stock returns of the selected banks at the 99% confidence level in 2022, and takes it as the management's consistent expectation of the maximum loss level of commercial banks.

### 3.2.2. Analysis of Indicators

The CVaR value can feedback the risk expectation of the enterprise from the circulating stock in the market, and the asset-liability ratio is the index that can feedback the risk resistance ability of the enterprise's own capital as a whole. Therefore, the coordinate system shown in Figure 3 is constructed with the CVaR as the horizontal axis and the asset-liability ratio as the vertical axis. The internal risk level of SIVB and other three bankrupt banks is at the average level of the industry, but the risk of external market transactions can be expected at a relatively high level. Therefore, compared to the Federal Reserve's rapid increase of interest rate in 2022, the problem of risk underestimation is apparent, and the whole industry has the problem of risk underestimation, which is not the core contagion factor.



Note: Data are from Wind database and annual reports of banks.

Figure 3: Comparison of Risk Assessment Indicators of US Banking Industry

## 3.3. Risk Response: Index Selection and Comparison of Term Mismatch

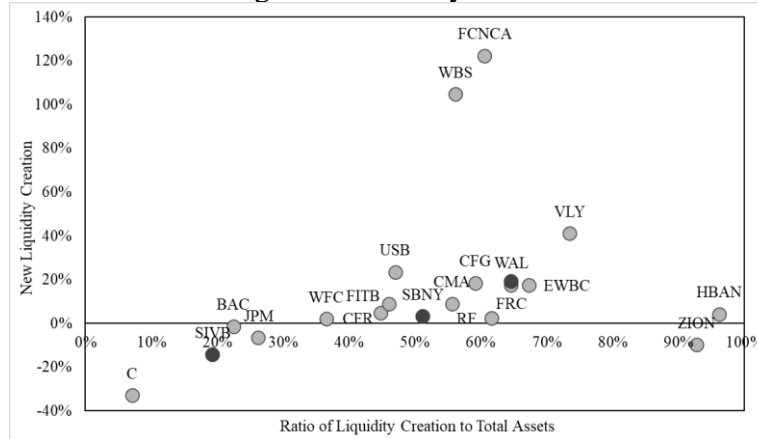
### 3.3.1. Index Selection

SVB chooses to invest in long-term financial assets to solve the risk of insufficient loans, which leads to the problem of maturity mismatch due to the use of wrong risk response methods. There are a large number of indicators to measure the term mismatch problem, of which the most basic one is the duration gap, and there are also a large number of management studies on the duration gap in the management of commercial banks (Li Beiwei, 2020)<sup>[12]</sup>. However, due to the inconsistency of the disclosure data of commercial banks and the different scope of disclosure, the above methods are difficult to achieve. This paper chooses the liquidity creation index proposed by Berger and Bouwman (2009)<sup>[13]</sup> as the measurement index of maturity mismatch.



### 3.3.2. Analysis of Indicators

As shown in Figure 4, this paper takes the proportion of liquidity creation to total assets as the horizontal axis to illustrate the term liquidity of assets and liabilities in stock, and takes the proportion of new liquidity creation as the vertical axis to illustrate the overall term allocation changes of banks in 2022 from the perspective of flow. Maturity mismatch can well explain the bankruptcy of SVB, but the liquidity of assets and liabilities of the two bankrupt banks is not much different from that of other banks, and the maturity allocation has not changed much in 2022, so maturity mismatch is not the core contagion factor of systematic risk in banking.



Note: Data are from Wind database and annual reports of banks.

Figure 4: Flow Stock Comparison of Liquidity Creation Indicators in the US Banking Industry

### 3.4. Control Activities: Index Selection and Comparison of Deposit Stability

#### 3.4.1. Index Selection

For the run risk of commercial banks caused by the lack of deposit stability, the indicators constructed by relevant studies can be mainly divided into two categories: from the perspective of the balance of balance sheet, the risk of potential insolvency of deposit liabilities is measured by the reverse scale of loans that occupy the main position on the asset side (Sun Guofeng, 2017)<sup>[14]</sup>; Starting from the deposit structure, the liquidity mismatch index is constructed to measure the liquidity mismatch problem of industry banks, and then reflect the risk of bank runs (Qiu Xiang, 2015)<sup>[15]</sup>.

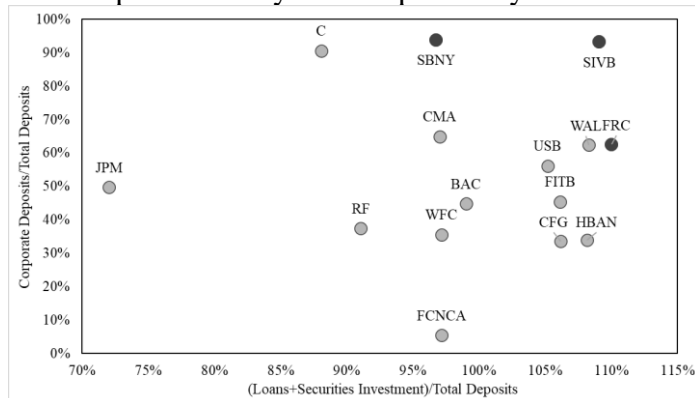
Because the problems caused by SVB run are related to the expansion of financial investment scale, the liquidity mismatch index is used and simplified on this basis: the liquidity difference between corporate deposits and personal deposits is used to construct the proportion of corporate deposits to total deposits as a reflection of deposit stability.

### 3.4.2. Analysis of Indicators

As shown in the Figure 5, the proportion of public deposits to total deposits on the vertical axis indicates the deposit structure of the bank. Once the bank has problems in operation, the outflow of public deposits will be faster and the risk of bank runs will be greater. The proportion of loans and securities investment in total deposits on the horizontal axis reflects the use of bank funds. The liquidity of loans and securities investment is poor, and the higher the proportion, the more difficult it is to liquidate assets after the occurrence of bank runs.

SIVB, SBNY and FRC are all in the upper right corner of the chart, and WAL and CLA in the

upper right corner are greatly affected by systemic risk, and the stock price has fallen significantly, which has the common problem of deposit flight. It can be seen that the deposit stability index has a clear distinction effect on bankrupt banks and banks which are greatly affected by systemic risk, which shows that the lack of deposit stability is an important systemic risk contagion factor.



Note: Data are from Wind database and annual reports of banks.

Figure 5: Comparison of Deposit Flexibility in US Banking

In summary, the lack of deposit stability is co-existing between SVB and the SBNY and FRC, which went bankrupt after it, and the other three are more of an influence on SVB's bankruptcy and are not central to systemic risk contagion.

#### 4. Comparative Analysis of Deposit Flexibility Indicators of China's Banking Industry

In order to analyse China's banking industry as a whole, and to explore whether the lack of deposit stability will transmit the systemic risk of SVB bankruptcy to the country, this paper selects the financial data of six state-owned banks from 2012 to 2022 to take the weighted average according to the size of their total assets and summarise them to form the financial statements of China's large commercial banks. The essay selects the financial statements of the top five banks with the size of their total assets among the urban commercial banks and the agricultural commercial banks to take the weighted average according to the size of their total assets. The financial statements of the top five banks in the total asset size of urban commercial banks and agricultural commercial banks are selected to generate the financial statements of small and medium-sized commercial banks in China according to the weighted average of their total asset size for analysis. Specific banks are selected and weighted as shown in Table 2 below.

Table 2: Proportion of Total Assets of Large and Small and Medium Sized Commercial Banks in China

Large Commercial Banks	Proportion to Total Assets	Small and Medium Sized Commercial banks	Proportion to Total Assets
Agricultural Bank	18.67%	Bank of Ningbo	13.22%
Bank of Communications	8.15%	Bank of Jiangsu	17.17%
Industrial and Commercial Bank	24.57%	Bank of Beijing	20.06%
Postal Savings Bank	8.80%	Bank of Nanjing	11.47%
China Construction Bank	21.14%	Bank of Shanghai	17.40%
Bank of China	18.67%	Shanghai Rural Commercial Bank	7.60%
		Chongqing Agricultural and Commercial Bank	8.30%
		Qingnong Commercial Bank	2.82%
		Ruifeng Bank	0.90%
		Zhangjiagang trip	1.08%
Total	100.00%	Total	100.00%

Note: Data Are from the Annual Reports of Banks.



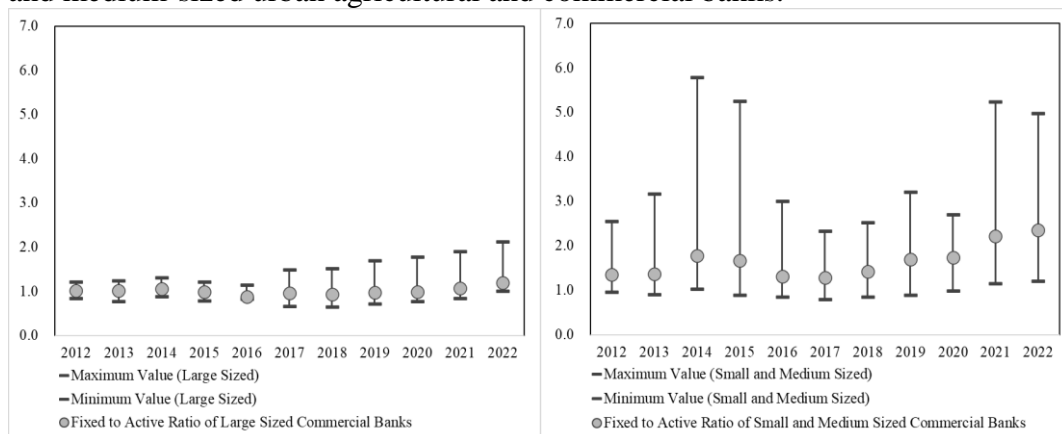
## 4.1. Calculation and Comparative Analysis of Relevant Indicators

### 4.1.1. Analysis of Deposit Stability Indicators

As shown in Figure 6, on the whole, China's deposit stability is stronger, and the stable source of funds makes Chinese banks generally willing to accept a larger proportion of capital occupation. Therefore, in the short term, China's banking industry is not affected by the bankruptcy of SVB, and the contagion factor of deposit loss caused by the lack of deposit stability is not obvious in China.

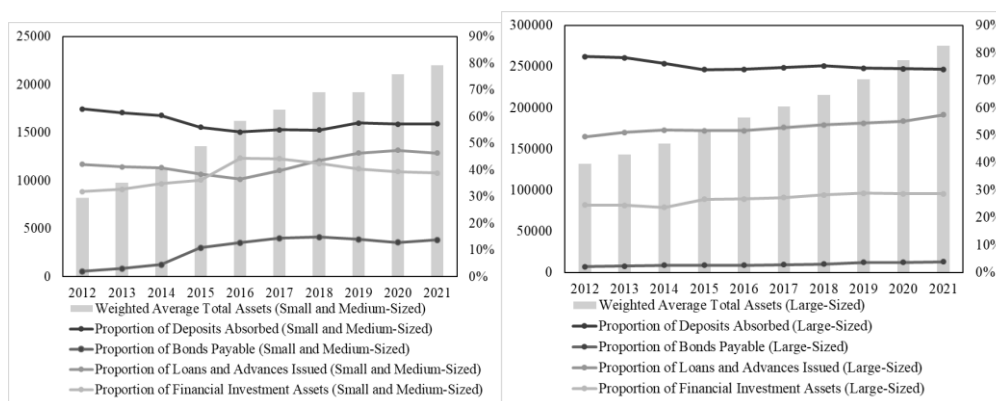
### 4.1.2. Analysis of the Structure of Deposits and Other Statements

As shown in Figure 6 below, the structure of fixed and current term deposits of large commercial banks in China is stable, while the proportion of fixed term deposits of small and medium-sized commercial banks varies greatly, and there is an overall upward trend in the proportion of fixed term deposits. However, the rise of time deposits is accompanied by a decline in the overall scale of deposit absorption, indicating that the problem of deposit outflow in China's banking industry occurs slowly and is compensated by higher-cost financial liabilities, which is particularly evident in small and medium-sized urban agricultural and commercial banks.



Note: Data are from Wind database and annual reports of banks.

Figure 6: Comparison of the Ratio of Fixed Deposits to Active Deposits in China's Banking Industry



Note: Data are from Wind database and annual reports of banks.

Figure 7: Comparison of Report Structure in China's Banking Industry

As shown in Figure 7, the average difference of interest payment level among large commercial banks is relatively small, while the difference of deposit interest payment level among small and

medium-sized banks is also expanding due to the huge internal difference of fixed and active ratio, which will induce small and medium-sized banks that are not dominant in the competition to collect deposits at high interest rates, thus there is a hidden danger of operational risk expansion.

#### **4.2. Analysis of China's response to the bankruptcy of Silicon Valley Bank**

On 15 May 2023, the People's Bank of China (PBOC) released its Monetary Policy Implementation Report for the first quarter of 2023, which listed the Silicon Valley Bank incident and its implications (Monetary Policy Analysis Group of the PBOC, 2023)<sup>[16]</sup>. The report's emphasis on avoiding large monetary policy withdrawals and releases corresponds to the problem of financial investment losses in banks such as SVB caused by the Federal Reserve's over-expected interest rate hikes, the emphasis on the regulation of small and medium-sized financial institutions corresponds to the problem of insufficient regulation of fourth-tier banks such as SVB in the U.S. Among them, the article "Concern about the stability of the structure of bank assets and liabilities" emphasizes the problems of high homogeneity of deposit customers, low proportion of insured deposits, unbalanced asset allocation and insufficient hedging arrangements.

The People's Bank of China's response plan on deposit stability is mainly to give full play to the role of the deposit insurance system, improve the management mechanism of the financial stability guarantee fund, and focus on strengthening the prevention of the harm of insufficient deposit stability, which is biased towards ex post prevention. There is a lack of prior adjustment for the loss of deposits in the long-term operation of banks and the reinvestment risk caused by the expansion of the debt-side duration gap.

### **5. Conclusions and Recommendations**

This paper constructs and analyzes four indicators of SVB and the US banking industry, including unrealized losses, risk expectations, term allocation, and deposit stability. The results show that the lack of deposit stability is the core factor of systemic risk contagion in the US banking industry caused by the bankruptcy of SVB. At the same time, through the in-depth analysis of the deposit stability index of China's banking industry, we can find that although the deposit stability of China's banking industry is strong, the loss of deposits in China is long-term. Therefore, China is less likely to be infected by the systemic risk of the US banking industry in the short term, but there are long-term operational problems in the stability of deposits.

In order to ensure that China's deposit stability is in a reasonable range for a long time and prevent the operational risks and reinvestment risks brought about by the expansion of the duration of liabilities. With the combination of the long-term deposit and loan business expectations brought about by the changes in macro-indicators, it is suggested that China's banking regulatory policies can be optimized from the following two aspects.

#### **5.1. Pay attention to the control of small and medium-sized banks' high-interest deposit collection behavior to avoid operational risks.**

Compared with large state-owned commercial banks, small and medium-sized commercial banks have weaker ability to obtain deposits and more serious internal differentiation. The gradual loss of demand deposits in the banking industry will inevitably intensify the competition for deposits in the industry, which may lead to high-interest deposit-taking behavior, and then have an improper competitive impact. With the lowering of deposit interest rates by major commercial banks, the regulatory authorities should pay attention to the monitoring of deposit interest rates of small and medium-sized banks, and urge them to strengthen the supervision of the personnel behavior of the

internal deposit-taking and lending departments, so as to keep the deposit review level in a reasonable range and avoid operational risks.

## 5.2. Strengthen macro-policy guidance, adjust and optimize the structure of long-term deposit liabilities.

Considering the macro trend of economic recovery after the epidemic and the recovery of M2, social finance and PMI indicators in 2022, the deposit and loan business of commercial banks will rebound to a certain extent, and it is also an opportunity for macro-adjustment. Supervision and macro-control departments should pay attention to the hidden dangers in the changing trend of China's long-term deposit structure, regulate and stabilize the healthy competition of China's commercial banks, adjust the long-term balanced deposit and loan structure of the banking industry, and prevent the long-term potential risks.

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