An Empirical Study on the Impact of Liquidity on the Risk of Financial Institutions

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Abstract. Select 32 financial institutions as the research objects, use the relevant data from 2012 to 2021 to calculate the value at risk of financial institutions and build a fixed effect model to analyze the relationship between financial risks faced by financial institutions and liquidity. The results show that the liquidity of financial institutions has a significant negative impact on the financial risks they face. At the same time, the OLS, random effects, and systematic GMM models are used to test the robustness. The results show that the conclusion is robust. This shows that the more abundant the liquidity of financial institutions, the less financial risks they face.

Keywords: Liquidity, Financial risk, Fixed effect model, Systematic GMM model.

1. Introduction

For a long time, liquidity risk has not been widely concerned by the financial industry. It was not until the financial crisis in 2008 that the lack of liquidity risk management in the risk management of large financial institutions was highlighted. Since then, countries have strengthened the supervision of risks in the financial sector, especially large financial institutions. These financial institutions themselves also attach importance to self-generated risk management, and analyze the influencing factors that may aggravate institutional risks and losses. The liquidity of corporate assets determines whether the company can cash in time to protect itself when faced with risks. What is the impact of lower liquidity on potential risks? How much impact does it have? It will be more practical to quantitatively study the impact of liquidity on risks in the daily operating state of enterprises, which will allow different types of financial institutions to know how to regulate and control business strategies to prevent risks. The differences between the situations of financial institutions are all need to be subdivided and explored.

2. Literature review

An important part of financial risk is liquidity risk, so the liquidity of a financial institution has a crucial impact on the financial risks it faces. However, the attention of the regulators in various countries on liquidity risk started relatively late. It was not until the revision of the Basel Accord in 2004 that the liquidity requirements were separated from the capital adequacy regulations, forming a preliminary liquidity supervision system. And China did not officially release the "Commercial Bank Liquidity Risk Management Measures" until 2018.

Since the sub-prime crisis in 2008, scholars have paid particular attention to the research on the relationship between liquidity and commercial bank risk. On the one hand, some scholars believe that the liquidity ratio of commercial banks and the systemic risk of the market often show a positive relationship. Acharya et al. (2010) [1] and King (2013)[2] believe that once commercial banks have a high liquidity ratio, it will strengthen the banks' willingness to bear risks, stimulate banks to extend excessive credit, and increase systemic risks. Zuo Wei et al. (2018)[3] also believe that higher micro

liquidity constraints will increase the negative impact of macro monetary policy on investment, output and other macroeconomic variables.

On the other hand, some scholars believe that the lack of liquidity is closely related to the formation, accumulation and diffusion of systemic risk. The facts show that the liquidity crisis is the precursor and concentrated expression of various financial crises. The most intuitive reaction to the outbreak of financial crisis is liquidity-dry-up. The central bank usually supplements macro liquidity through monetary policy regulation, although sometimes it can not fully meet expectations[4]. Karlina et al. (2020)[5] believe that liquidity has a positive impact on the value of the company, thus inhibiting the generation of risks. Chang Jinghan and Yang Wendi (2021)[6] used the digital inclusive financial index as the regulatory variable of liquidity risk to study its mechanism of action on systemic risk, and obtained the negative correlation between liquidity level and systemic risk.

On the research object, the measurement of systemic risk from the macro perspective includes the traditional SCCA model (Liu Chao et al., 2019)[7] and the vinecopulascca semi parametric model (Gong Jinguo et al., 2022)[8]. At the micro level, with the increase of the financial market uncertainty, the advantages of VaR model are obvious. VaR model has been frequently applied to the financial field and has become a key model for financial risk measurement under the new economic situation[9]. Therefore, this paper uses VaR model to measure the risks they face. As for the measurement of liquidity, most of the existing studies are based on the macro level. For example, many scholars use more intuitive quantitative indicator, money supply, to measure liquidity[10]; some scholars have also constructed price indicators and quantity indicators to characterize global liquidity in order to more effectively reflect the dynamic changes of liquidity[11]. In this paper, the micro liquidity level of financial institutions is measured by their current ratio.

From a comprehensive analysis of the above literature, there are fewer research literatures on the risk of financial institutions. However, the risk studied in most literatures is the risk of the entire market or the contribution rate to systemic risk. There are few literatures on the impact of financial institutions' own risks. Therefore, it is necessary to study the impact of financial institutions' liquidity on their own financial risks. This paper draws on the previous literature, uses VaR to measure the risk of financial institutions, and constructs a fixed -effect model to empirically test the impact of liquidity on the risk of financial institutions.

3. Model setting and data description

3.1 Data sources

All the data in this paper are from CSMAR. Among the 131 financial institutions in the 2012 industry classification released by China Securities Regulatory Commission, 32 institutions with the most complete liquidity data are selected as samples for research. The measure index of financial risk, 99% value-at-risk, is the 1% quantile of a normal distribution whose mean and variance are calculated using the data of stock prices change ratio from CSMAR.

3.2 Variable settings and descriptive statistics

Explained variable is VaR, which is used to intuitively represent the size of the risk value. Explanatory variables are set from four aspects: liquidity, solvency, operating ability and profitability. The variable settings are shown in Table 1. The descriptive statistics of the main variables are shown in Table 2.

Table 1: Variable Settings

Variable type	Variable ID	Variable name	Variable meaning and description
Explained variable	VaR	Value at risk	Measuring the risk index of financial institutions
Explanatory variables	CR	Current ratio	Current assets/Current liabilities
	TOAR	Turnover of account receivable	Operating income/Accounts rceivable closing balance

Control variables	CI	Capital intensity	Total assets/Operating income
	IPM	Interest coverage ratio	(Net profit + Income tax expenses + Finance expenses) / Finance expenses
	TALR	Tangible assets liability ratio	Total liabilities/ (Total assets - Net Intangible assets - Net goodwill)
	AR	Accounting robustness	Calculated using the Basu model

Table 2: Variable Descriptive Statistics Table

Variable	Obs	Mean	Std.dev.	Min	Max
VaR	1251	-6.7201	2.9069	-21.530	-1.7592
CR	1210	6.4445	115.39	-12.372	4010.5
CI	1202	81.606	529.31	-0.0811	10836
AR	1278	1269.6	16813	0.4700	5e +05
IPM	996	44.795	489.55	-257.13	13424
TALR	1280	0.5571	0.3968	- 10e -03	7.2779
TOAR	1280	0.4149	0.6473	-0.4532	2.2434

3.3 Model settings

This paper first puts forward the following three assumptions about the model used:(1) The model has individual effects on the cross section. (2) The model has fixed effects on time points and individuals. (3) There is no structural change in the model, The qualitative analysis decides to apply the variable intercept model. The general variable intercept model regression equation has the following form:

$$Y_{it} = \alpha_i + X_{it}\beta + \mu_{it} + \varepsilon_{it} \qquad i = 1,2 \dots n \ , t = 1,2 \dots n \tag{1}$$

Lu Menglong (2007) [12] pointed out in his research on economic evolution and employment elasticity measurement that some variables representing individual characteristics were not included in the model as explanatory variables either because they were unobservable or because of research convenience, but they are relevant to the subject being examined. At this time, it is possible to directly adopt the fixed effect model and omit the procedure of the Hausman test. This is the case studied in this paper. To analyze the impact of liquidity on the VaR of different institutions, in addition to the current ratio, other control variables also need to be considered. The final model has fixed effects for both individuals and time points, so the specific model setting form is as follows:

$$\mathrm{VaR}_{it} = (\alpha_i + \alpha_t) + \mathrm{CR}_{it}\beta_1 + TOAR_{it}\beta_2 + CI_{it}\beta_3 + IPM_{it}\beta_4 + TALR_{it}\beta_5 + AR_{it}\beta_6 + \mu_{it} \tag{2}$$

Among them, α_i(i =1,2,3...,32) is the individual fixed effect, α_t(t=1,2,3...,40) is the time point fixed effect, $(\alpha_i + \alpha_t)$is the intercept term, β_i(i=1,2,3,4,5,6) are the coefficients of explanatory variables and control variables, $\mu_{it}$is disturbance term.

4. Empirical Analysis of the Impact of Current Ratio on the Value-at-Risk of Financial Institutions

4.1 Correlation Analysis of Variables in the Effect of Current Ratio on VaR

Among the Kendall correlation coefficients in Table 3, it is generally lower than 0.2, and the correlation coefficient between the tangible asset-liability ratio and the current ratio is up to 0.26, but it does not cause multicollinearity. Because the current ratio used here can measure the ability of the company's current assets to be immediately realized, so as to more deeply reflect the competitiveness of the company. While the tangible asset-liability ratio used reflects the company's use of creditors to provide funds to carry out. It also reflects the security of the creditor's loan issuance. The tangible

asset-liability ratio and the current ratio are all control variables that need to be added. And we will retain them for a more comprehensive analysis from the aspects of solvency and operating ability.

Table 3: Correlation coefficient table

	CR	TOAR	CI	IPM	TALR	AR
CR	1.0000	-0.0501	-0.0136	0.0804	-0.2620	0.0259
TOAR	-0.2377	1.0000	-0.0211	-0.0147	0.0709	-0.0048
CI	0.0741	-0.2482	1.0000	-0.0038	0.0212	0.0506
IPM	0.0526	0.1115	0.3122	1.0000	-0.0189	-0.0166
TALR	-0.5572	0.0306	0.2492	-0.0459	1.0000	0.0072
AR	0.0250	-0.0059	0.3609	0.1060	0.0969	1.0000

Spearman correlation coefficient lower left, Kendall correlation coefficient upper right

4.2 Regression Analysis of Explanatory Variables on VaR

Through the fixed-effect variable-intercept model of the stepwise regression of the preceding item in Table 4, we can obtain:

Since our data VaR uses a negative number to represent the occurrence of risk losses, a positive regression coefficient indicates a reduction in the occurrence of risks, and a negative coefficient indicates an increase in risk loss exposure.

The core explanatory variable of this paper, current ratio (CR), has a significant positive correlation with VaR. At the 5% confidence level, for every 1 unit increase in it, VaR increases by 0.03821 units. The current ratio is the proportion of current assets to current liabilities. The ratio reflects the proportion of the company's assets with strong liquidity. A higher current ratio is conducive to the company's timely preparation of funds needed to respond to emergencies, thereby reducing losses caused by risk exposure.

Among other significant variables, Interest Coverage Multiple (IPM), Accounts Receivable Turnover Ratio (TOAR) and VaR show a significant positive correlation, indicating that improving these financial indicators is conducive to reducing the risk loss of enterprises, while capital intensity (CI) on the contrary, the rise of this indicator will increase the possible losses of the enterprise.

Table 4: Fixed effects variable intercept model for stepwise regression of the former term

	Var				
CR	7.6e -04*** (-3.8e-05)	7.3e -04*** (-3.8e-05)	7.5e- 04*** (-3.6e-05)	0.03074 (-0.02091)	0.03821*** (-0.01648)
CI		-2.0e-06*** (-9.7e-08)	-2.3e-06*** (-2.1e-07)	-2.1e-06*** (-2.2e-07)	-2.1e-06*** (-3.0e-07)
AR			0.20504 (-0.13047)	0.12314 (0.14914)	0.16965 (-0.14237)
IPM				2.9e -04*** (-4.5e-05)	2.9e -04*** (-4.3e-05)
TALR					0.36671 (-0.26792)
TOAR					0.00436*** (-0.00122)

Standard errors in parentheses $^{*}\ p < 0.1$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

4.3 Robustness check

In order to test the robustness of the model, this paper replaces the method with OLS robust standard error, random effects model and systematic GMM model to re-estimate. Before using the systematic GMM model, the Hausman test is carried out on all explanatory variables and control

variables, finding that the tangible asset-liability ratio and accounting conservatism are endogenous at the 15% significance level, so the lag terms of the two endogenous variables are used as instrumental variables in systematic GMM estimation, and the results are shown in Table 5. It can be seen that, except for the system GMM model, the results of other methods are almost the same as the original model, indicating that the robustness of the model constructed in this paper is marvelous. The bias of the estimated result in the system GMM model may be due to the introduction of lag terms of the explained variable.

Table 5 Robustness test results

	OLS robust standard error	Random effects	System GMM
CR	0.01980* (0.01141)	0.0210 *** (7.8+e-03)	-0.06047 (0.04177)
CI	-1.1+e-06 (1.5+e-06)	-1.3+e-06 * (6.9+e-07)	3.3 +e-06 * (1.9 +e-06)
AC	0.17116 (0.12 391)	0.17240 (0.14851)	-0.4062 *** (0.11881)
ICR	2.3+e-04 *** (4.0+e-05)	2.4+e-04 *** (5.4+e-05)	1.0+e-04 (1.2+e-04)
TALR	0.45570 * (0.23371)	0.43763 (0.3508)	-1.178 04 (1.02879)
ART	2.7+e-03 *** (9.6+e-04)	3.1+e-03*** (9.4+e-04)	5.5+e-04 (1.8+e-03)
L.var99			0.7409 *** (0.05136)

Standard errors in parentheses，$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

4.4 Heterogeneity analysis

Different financial situations faced by the institutes also lead to different degree of impact of liquidity on their financial risks. Therefore, this paper conducts a group regression according to the net profit and total asset size.

The results of the net profit group regression are shown in Table 6. It can be seen that as the net profit of financial institutions decreases, the impact of liquidity on financial risks becomes more significant. This may be because low-profit financial institutions often take on higher leverage to gain profits. So their lower equity capital ratios make them more vulnerable to shocks and need to maintain sufficient liquidity to respond.

The regression results of asset size grouping are shown in Table 7. The financial institutions with small assets are the most affected by liquidity, while the financial risks faced by larger financial institutions are more determined by asset intensity, accounting conservatism and other factors compared with liquidity. Because the larger the asset size, the easier it is to raise funds to deal with emergencies, the importance of maintaining high liquidity decreases accordingly.

Table 6 Grouping regression results of net profit

	low net profit	medium net profit	high net profit
CR	0.0510 *** (0.0122)	-0.0625 (0.0786)	0.0743 (0.0461)
CI	-1.3 +e-06 *** (2.3+e-07)	-6.8+ e-05 *** (1.2+e-05)	3.2+e-04 (2.8+e-04)

AC	-0.3571 (0.1977)	0.1728 (0.2453)	0.6775 *** (0.1934)
ICR	-4.3+e-03 (9.8+e-03)	3.2+e-04 *** (5.4+e-05)	-6.5+e-03 (6.1+ e-03)
TALR	0.0368 (0.1275)	1.1932 *** (0.2464)	1.434 4 ** (0.4843)
ART	9.1+e-03 ** (3.2+e-03)	-3.7+e-04 (1.1 + e-03)	4.2+e-03 *** (5.8 + e-04)

Standard errors in parentheses，$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 7 Grouping regression results of asset size

	small scale	medium scale	massive
CR	0.0506 *** (0.0117)	0.0287 (0.0719)	6.84+e-03 (0.1568)
CI	-8.9+e-04 * (4.4+e-04)	-2.5+e-06 *** (3.1+e-07)	-6.2+e-05 ** (2.7 + e-05)
AC	-0.2059 (0.1686)	0.1079 (0.2321)	0.6289 *** (0.1784)
ICR	5.7+e-04 (6.3+e-03)	-8.5+e-03 (4.8+e-03)	2.9+e-04 *** (5.3+e-05)
TALR	0.0851 (0.1389)	1.1004 ** (0.4131)	1.1691 *** (0.2801)
ART	4.5+e-03 (3.5+e-03)	4.4+e-04 (4.6+e-03)	4.1+e-03 *** (4.8+e-04)

Standard errors in parentheses，$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

5. Results and Policy Implications

5.1 Research result

In view of the impact of liquidity on the risk of financial institutions, this paper collects the current ratio, capital intensity and other related data of 32 Chinese financial institutions from the first quarter of 2012 to the fourth quarter of 2021. First, the stock price change is regarded as the income of the institution. Calculate the mean and variance to form a normal distribution, construct a risk index for financial institutions, and build a fixed-effect model to study the impact of liquidity on the risk of financial institutions. The main conclusions are as follows: (1) More abundant the liquidity of financial institutions, the less financial risks they face. (2) With the improvement of the net profit of financial institutions, the impact of liquidity on the risks of financial institutions has become more and more significant. (3) The effect of liquidity on the risk of financial institutions shows an increasing trend, so financial institutions with small assets are most affected by liquidity.

5.2 Policy Implications

In response to the three research conclusions above, this paper gives three policy implications:

(1) Financial supervision and management departments should strengthen the update and revision of liquidity risk supervision policies. China's current liquidity risk supervision system is still in its infancy, and a large amount of factual data is still needed as an effective verification basis. Therefore, according to the characteristics of the reform and opening up and the Internet economy era, and in combination with the operation status of China's financial institutions, we should constantly update

and revise the relevant regulatory systems and policies, and find out the liquidity risk regulatory methods that suit China's national conditions.

(2) Financial institutions with high profits should not blindly pursue more returns, but should strengthen liquidity management and try to prevent the risks brought by the rebound of leverage ratio. There is an alternative trade-off between liquidity and profitability. The more resources a financial institution devotes to meeting liquidity needs, the less likely it is to be profitable (all other things being equal). Ensuring adequate liquidity is a constant management theme, and it has significant implications for the profitability of financial institutions.

(3) Financial institutions with small and medium-sized assets should pay more attention to the impact of liquidity on their own risks, and formulate their own risk management systems based on their own development and market conditions. Due to the relatively limited capital quantity of small and medium-sized financial institutions, and at the same time blindly imitating large financial institutions in terms of risk prevention and management systems, there is no risk prevention system constructed according to their own development and market conditions, so it is difficult to avoid risks. If there is a shortage of liquidity, it is very likely that financial institutions will be in trouble and even lead to bankruptcy.

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