# FINANCIAL VULNERABILITY, CAPITAL SHOCKS AND ECONOMIC GROWTH: EVIDENCE FROM CHINA (2005–2014)

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## ABSTRACT

Taking the leading role of the banking industry in the financial system into consideration, this paper constructed a financial vulnerability index by using the method of principal component analysis, and found China's financial vulnerability showed a slightly upward trend in general. In order to confirm the macro factors affecting financial fragility, dynamic regression models were constructed. As a result, the authors obtained seven major macro factors. Finally, the authors determined that an overheated economy, increasing inflation, excessive growth of the country's fiscal expenditures, and export shocks will increase financial vulnerability. However, the increasing investment in real estates and fixed assets may reduce the risk in the financial market. Therefore, China needs to adapt to the new normal economic development model, weaken government intervention in the financial markets, deepen financial reforms, and maintain steady development in the financial system.

## KEY WORDS

banking industry, financial vulnerability, capital shocks, economic growth, China, measurement

## JEL CODES

C13, E10, G21

## 1   INTRODUCTION

With the deepening reform of China's financial system in recent years, the efficiency of financial services has gradually improved. Obviously, this industry plays an important role in the rapid development of the Chinese economy. However, a lot of problems have hindered the healthy development of the financial industry, such as an unbalanced structure, incomplete reforms, and poor quality financial institutions. In addition, a series of problems caused by the rapid economic development have been passed on to the financial system and have

formed potential risks. Moreover, upgrading to the international level has also introduced risks. Therefore, it is important to accurately measure China's financial vulnerability, formulate effective solutions, and establish preventive mechanisms.

The vulnerability of the financial system includes the vulnerability of financial institutions and markets. In the meantime, financial system has become increasingly fragile (Johnston et al., 2000; Liu, 2012; Tropeano, 2013). Explaining the financial fragility hypothesis from the perspective of the enterprise, Minsky (1982) thought that the intrinsic characteristics of an organization creating private credit could lead enterprises to face the dilemma of bankruptcy caused by a cyclical crisis; furthermore, the dilemma may have a negative impact in other areas and result in economic crisis. From the perspective of banks, Kregel (1997) proposed the security boundary theory, and he argued that financial fragility was negatively related to security boundaries. In a financial system dominated by banking, the fragility of banks represents fragility in the financial system to a great extent. Diamond and Dybvig (1983) thought that the uncertainty of liquidity demand and the liquidity shortage on banking assets would lead to banking vulnerability. Mishkin (1991) believed that asymmetric information in the credit market caused the problem of adverse selection. Due to information asymmetry in the information deposit market, a "prisoner's dilemma" will be created, causing a run on deposits. Therefore, inherent fragility exists in financial institutions. After the Asian financial crisis in 1997, some studies showed that macroeconomic shocks, fluctuations in asset prices, and inappropriate monetary and exchange rate policies may increase financial risks and result in financial instability (Orlowski, 2008). According to Beck et al. (2003), the financial crisis occurred in countries with relatively fragmented banking structures generally. Tornell et al. (2004) studied the relationship between financial liberalization and risk. Bekaert and Harvey (2000) found financial liberalization reduced capital costs and promoted economic growth. Fell and Schinasi (2005) believed that, the financial stability index should not only include the information of various departments in the financial system, but also consider the dynamic factors. That is, we should consider the relationship between financial and economic. Then A Financial Stability Index (FSCI) is proposed to study financial instability by van den End and Tabbae (2005), Hatzius et al. (2010) and Brave and Butters (2011).

Some scholars have studied the Chinese financial system. Chen and Wu (2004) conducted a quantitative analysis on China's banking system vulnerability[1] and concluded that the banking system was unstable for 11 years between 1978 and 2000, especially around 1992 and 1998. Wan (2008) used the dynamic factor analysis method to build a financial vulnerability index and found that it showed a downward trend from 1987 to 2006. Chen et al. (2011) studied the change in financial vulnerability by using the smoothing mechanism transfer model. As a result, they determined that the Chinese banking system had a higher degree of vulnerability after 2007. He and Lou (2011) studied Chinese financial system and analyzed financial stability by principal component analysis.

Throughout the financial vulnerability studies, the literature mostly focused on the vulnerabilities surrounding the subprime crisis (2008), but there has been limited research on changes in the financial system vulnerability after 2010. Also, in terms of research content, authors tend to concentrate on exploring the trend of financial system vulnerability while few have studied the macro factors affecting vulnerability.

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[1] Chen Hua and Wu Zhiwen selected some indicators to measure the vulnerability of the banking system, including the rate of change in the savings deposits of urban and rural areas, bank loans to non-government sector growth rate, CPI index and the CMAXt index.

# 2   DATA AND METHODOLOGY

In this article, the authors will use the principal component analysis method to measure and analyze the trends of financial fragility in China from 2005 to 2014. Then the authors will establish several regression models to identify some of the macroeconomic factors which affect vulnerability.

## 2.1   Financial fragility index

The broad functions of banks have a significant impact on all social and economic activities. Data show that total assets in China's financial industry amounted to 50.27 trillion RMB in 2005, and banking sector assets accounted for 74.5% of this total. To the end of 2011, the proportion of banking industry assets in financial industry assets had been more than 90%. Although it can be seen that the total assets of the banking industry absolutely occupied the dominant position in the country's financial industry, it should also be recognized that the risks in China's financial system were concentrated in the banking system to a large extent. Therefore, it is both necessary and scientifically sound to select a banking system index as a proxy index to measure financial industry vulnerability.

The authors selected five indicators to synthesize a financial vulnerability index (represented by JRC in below). These are the loan growth rate[2], the proportion of medium and long term loans in total loans, the loan and deposit ratio, the growth rate of inter-bank credit, and the foreign asset growth rate. The reasons for choosing these indicators will be explained in section 2.1.1.

### 2.1.1   Variable description and data sources

In China, as some bad loans are extended or moved out from the balance sheet, the authenticity and reliability of the non-performing loans ratio requires further investigation. Consequently, the authors measured the credit risk of the banking system by using the loan growth rate and the proportion of medium

and long term loans in total loans. Liquidity risk is an important risk for banks, so in this paper the authors selected the deposit and loan ratio to measure it. When the ratio is lower, liquidity risk is smaller; but if the asset-liability ratio is at a very high level, banks are more likely to face bankruptcy risks resulting from external shocks. If this happens, the risk will quickly pass through the entire banking system, and may even have a serious impact on the macro economy. Therefore, it is necessary to measure the possibility of contagious risks by using the growth rate of bank credit. As economic globalization has developed, small changes in the international market may affect the stability of the domestic banking system, therefore the foreign asset growth rate must be considered as an important indicator of risk measurement.

Taking the availability of data into account, authors selected data from the first quarter of 2005 to the third quarter of 2014, and these data are chosen from the Chinese economic and financial database (CCER).

## 2.2   Regression model of macro factors

In order to further explore the factors influencing financial fragility, the authors selected several macro variables and then created dynamic regression models to filter out suitable variables. Finally, a regression model was established to analyze the influence of these macro variables on financial fragility.

### 2.2.1   Selection and description of macroeconomic variables

The trend line of the JRC index depicts the overall change in risk in the Chinese banking industry over the past ten years. Due to the significance of the banking industry in the financial sector, it is reasonable to use the index to measure the financial system risk. The JRC index can only describe changes in risk, it cannot judge the impact of macro factors on

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[2]In this paper all growth indicators are the year-on-year growth rates.

the financial system. On the basis of drawing lessons from international experience and related research results, the authors selected the following macro factors.

Economic cycle indicators are mainly the nominal GDP growth rate (NGDP), actual GDP growth rate (SJGDP), and export growth rate (ET). It is well known that GDP indicates the state of the current macro economy. Rapid economic development will increase production and sales, further improving the repayment performance of corporations. As a result, it is effective in reducing the liquidity risk of the banking industry. At the same time, banks can also provide loans to enterprises, so that enterprises can expand production, forming a virtuous circle which stimulates the economy to further prosperity. Since China joined the WTO, the rapid growth of export trade has stimulated China's investment and consumption, expanded employment, and enhanced economic and social stability.

Price indicators include M2 growth rate (M2), the inflation rate (CPI), stock market price index (SMI), and the one-year deposit interest rate (ODR). M2 reflects the realistic and potential purchasing power, and also reflects middle market activity. The inflation rate is measured by the consumer price index CPI, which directly affects investment and consumption levels as well as government policy. The stock market price index reflects fluctuations in the stock market and the one year fixed deposit

rate (ODR) will have an impact on the deposits and loans of banks.

From the perspective of international indicators, foreign exchange reserves can regulate and control the economy, and further influence internal and external balance. Hot money[3] is short-term speculative funding which flows rapidly into the market in the pursuit of high returns. If the amount of hot money inflows (HM) is too much, the economic system will not operate normally, and the economy will fluctuate severely. The real exchange rate of the RMB (EXR) reflects the purchasing power in the international market. If the financial liberalization index (MFR) , the ratio of M2 and foreign exchange reserves is larger, the degree of financial liberalization will be higher, as will the degree of capital inflows.

Other indicators are set according to the actual Chinese situation, including the growth rate of real estate development and investment (EDI), fiscal expenditure (FS), and the growth rate of fixed asset investment (FAI). Chinese infrastructure construction, especially the development of real estate investment, stimulates the economy. The subprime crisis revealed that the collapse of the real estate market will have a serious effect on the country's economy. Changes in fiscal spending reflect the adjustment of government investment projects; and a growth rate of fiscal expenditure that is too fast reflects overheated government investment.

# 3   RESULTS

## 3.1   JRC index construction and trend analysis

Based on the principal component analysis method, the authors used SPSS17.0 to construct a JRC index. As can be seen from Tab. 1, the contribution rate of the loan growth rate is 49.034%, and the contribution rate for the proportion of medium and long term loans in total loans is 24.827%. These variables, whose characteristic value is greater than 1,

were counted by the authors and it was found that the cumulative contribution rate reached 73.861%. Thus these two variables can be used to measure the vulnerability of the financial system. The authors then weighted the contribution rate to get the JRC index:

$$\text{JRC} = 0.66387a + 0.33613b \qquad (1)$$

By calculation, the range of JRC is found to be $[1.523, 2.164]$. The authors then mapped it to $[0, 10]$. As can be seen in Fig. 1, China's

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[3]The amount of hot money inflows = foreign exchange reserves − foreign direct investment − trade surplus.

Tab. 1: The principal component analysis results

| Component | Initial eigenvalues | | | Extraction sums of squared loadings | | |
|---|---|---|---|---|---|---|
| | Total | % of variance | Cumulative % | Total | % of variance | Cumulative % |
| 1 | 2.452 | 49.034 | 49.034 | 2.452 | 49.034 | 49.034 |
| 2 | 1.241 | 24.827 | 73.861 | 1.241 | 24.827 | 73.861 |
| 3 | 0.642 | 12.838 | 86.700 | | | |
| 4 | 0.483 | 9.663 | 96.362 | | | |
| 5 | 0.182 | 3.638 | 100.000 | | | |

Notes: 1 – the loan growth rate; 2 – the proportion of medium and long term loans in total loans; 3 – loan and deposit ratio; 4 – the growth rate of inter-bank credit; 5 – the foreign asset growth rate
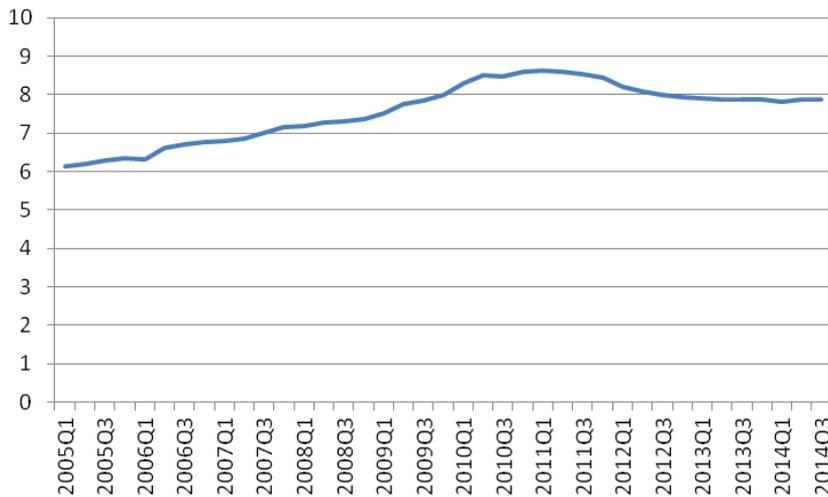


Fig. 1: The financial fragility index JRC

financial system vulnerability shows a slight upward trend in general, but the trend has its own characteristics in different stages. Generally speaking, the financial system after 2009 is more vulnerable than during 2005 to 2009. To be specific, the financial system vulnerability index is at a low level from Q1 2005 to Q1 2006. Compared with 2005, the financial fragility index rises slightly but still maintains relative stability in 2006. In this stage, several banks[4] have been listed, which indicates that the reform of the banking industry in China tends to be deepening and becoming more mature. From 2007 to Q1 2008, the JRC index shows a slightly upward trend. During this period, the economic investment growth rate accelerates, with monetary and credit growth increasing too quickly. At the end of Q1 2008, the cooling external environment and shrinking global demand causes a drag on China's exports because of the international financial turmoil. In the second quarter of 2009, the financial fragility index increased significantly. From 2011 to the second quarter of 2012 the index falls as both the global economy and exports have gradually been recovering. In 2011, the first year of the 12th Five-Year Plan in China, major infrastructure construction projects were started and these provided strong support for investment growth. The JRC index is at a stable level from 2012 to the third quarter of 2014. Within an environment of good macroeconomic development, deepening financial reform, and along with the implementation of real estate regulation and control measures, the financial system maintained a smooth performance.

[4]Bank of Communications, China Construction Bank, Industrial and Commercial Bank, and Bank of China
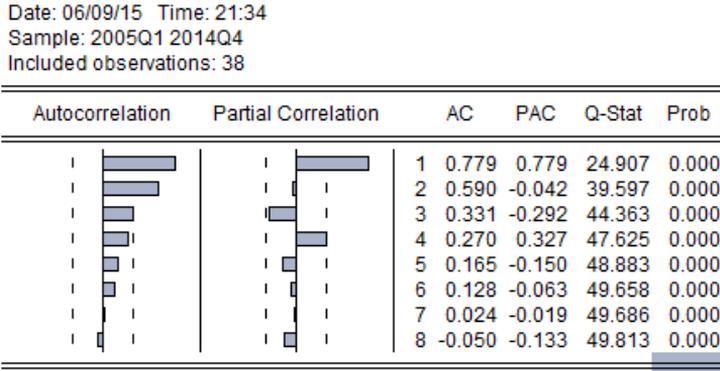
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Date: 06/09/15  Time: 21:34
Sample: 2005Q1 2014Q4
Included observations: 38
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| Autocorrelation | Partial Correlation | | AC | PAC | Q-Stat | Prob |
|---|---|---|---|---|---|---|
| | | 1 | 0.779 | 0.779 | 24.907 | 0.000 |
| | | 2 | 0.590 | -0.042 | 39.597 | 0.000 |
| | | 3 | 0.331 | -0.292 | 44.363 | 0.000 |
| | | 4 | 0.270 | 0.327 | 47.625 | 0.000 |
| | | 5 | 0.165 | -0.150 | 48.883 | 0.000 |
| | | 6 | 0.128 | -0.063 | 49.658 | 0.000 |
| | | 7 | 0.024 | -0.019 | 49.686 | 0.000 |
| | | 8 | -0.050 | -0.133 | 49.813 | 0.000 |

Fig. 2: The self correlation of DJRC sequence graph

Tab. 2: Dynamic regression models

| Variable | | | | Explanatory variable | | | | | Adjust |
|---|---|---|---|---|---|---|---|---|---|
| $X$ | Intercept | $y_{t-1}$ | $y_{t-2}$ | $X$ | $X_{t-1}$ | $X_{t-2}$ | $X_{t-3}$ | $X_{t-4}$ | $R^2$ |
| NGDP | — | 0.49081 | — | −0.1879 | — | — | 0.2596 | — | 69.28 |
| SJGDP | — | 0.8009 | — | — | — | −0.213 | — | — | 54.9 |
| ET | — | 0.4652 | 0.3386 | −0.086 | 0.09 | — | — | −0.048 | 71.86 |
| M2 | −0.0446 | — | 0.3972 | 0.0064 | 0.0016 | — | — | — | 75.09 |
| CPI | — | 0.4647 | 0.39921 | −0.2843 | — | — | 0.4042 | −0.3309 | 72.42 |
| SMI | −0.0247 | 0.6809 | — | — | — | — | — | — | 60.85 |
| ODR | — | 0.8085 | — | — | — | — | — | — | 52.37 |
| EXR | — | 0.8145 | — | — | — | — | — | — | 55.78 |
| FER | — | 0.7203 | — | — | — | — | — | — | 55.56 |
| DHM | — | 0.9160 | — | — | — | — | — | — | 56.60 |
| DMFR | — | 0.8099 | — | −0.0055 | — | — | — | — | 58.03 |
| DFAI | — | 0.8353 | — | — | — | — | — | 0.24596 | 64.63 |
| DEDI | — | 0.5462 | — | 0.2054 | 0.093 | — | — | — | 69.6 |
| DFS | — | 0.7528 | — | — | — | −0.00088 | −0.00083 | 0.00158 | 62.13 |

Note: The above regression models are self correlated. Therefore, Newey-West estimation was used and the significant level was 10%.

Tab. 3: Outcomes of model fitting and test statistic

| Explanatory varible | Coefficient estimation | $t$-statistic | $p$-value |
|---|---|---|---|
| Intercept | −0.093083 | −5.891421 | 0.0000 |
| NGDP(−2) | 0.280095 | 3.654928 | 0.0011 |
| ET | −0.081376 | −3.543551 | 0.0014 |
| CPI(−3) | 0.291982 | 2.832038 | 0.0085 |
| M2(−2) | 0.004379 | 7.103841 | 0.0000 |
| DFAI(−1) | −0.268938 | −2.882377 | 0.0075 |
| DEDI(−1) | −0.010541 | −2.249420 | 0.0349 |
| DFS(−2) | 0.000957 | 2.433468 | 0.0216 |
| Other statistics | $R^2 = 0.283$ | $A\text{-}R^2 = 0.779$ | DW = 2.0136 |

## 3.2 Macroeconomic variable selection

In order to avoid a false regression, authors made a stability test on the above indexes and the JRC sequence. According to the results of the ADF test, the variables are stable at the 95% significance level except the indexes of JRC, EDI, FAI, FS, HM, and MFR; the authors also found that the first order difference of these six sequences are stable.

From Fig. 2, it can be seen that there is second-order correlation for DJRC[5]. In order to ascertain the authenticity of the result, the authors established a self regression model on $y_t$ and found that the $t$-statistic will be more significant if the coefficient of lag order is 2. Therefore, it is concluded that the DJRC sequence is a second-order autocorrelation.

So the following regression model is established:

$$
\begin{aligned}
y_t = {} & \alpha_0 + \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + \\
& + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \\
& + \beta_3 X_{t-3} + \beta_4 X_{t-4} + \mu_t. \quad (2)
\end{aligned}
$$

Since the impact of macroeconomic factors on the financial system is lagging behind, the authors constructed 14 dynamic regression models. The results are shown in Tab. 2.

## 3.3 Regression model

The authors constructed a new model using the macro variables mentioned above having a high goodness of fit and gradually removed insignificant variables. After several adjustments, the model was obtained, and the results are shown in Tab. 3:

The model is as follows:

$$
\begin{aligned}
y_t = {} & -0.067442 + 0.238917\,\mathrm{NGDP}_{t-2} + \\
& + \mathrm{ET}_t + \mathrm{CPI}_{t-3} + \mathrm{M2}_{t-2} + \\
& + X_{2_{t-1}} + X_{3_{t-1}} + X_{4_{t-2}} + \mu_t \quad (3)
\end{aligned}
$$

In Equation 2, $X_2$ refers to DFAI, $X_3$ refers to DEDI, and $X_4$ refers to DFS.

# 4   DISCUSSION AND CONCLUSIONS

According to Equation 2, we can see the relationship between these variables (NGDP, CPI, M2, FS, ET, FAI and EDI) and financial fragility, as discussed in section 4.1. Taking the national situation into account, the authors will make recommendations on the basis of the research findings in 4.2.

## 4.1 Conclusion

*The coefficient values of NGDP, CPI, M2 and DFS are positive which indicates that these variables are positively correlated with the financial fragility index.*

Compared with the index of actual GDP, NGDP has a more significant influence on financial system vulnerability. NGDP has a negative correlation with the financial fragility index, which means that economic growth which is too fast will accelerate the fragility of the financial system. Previous studies generally considered rapid economic development to be helpful in improving the efficiency of financial services and reducing risks in the financial system. This study suggests that although economic overheating could promote financial innovation, it will breed a series of problems such as unreasonable economic structures and serious environmental pollution. As a result, financial risk increases.

A rising inflation rate will bring about an asset price bubble. The increase in the money supply will accelerate inflation, and further exacerbate the rate of inflation causing the bubble to become larger, a situation which is extremely unfavorable for the stability of the financial system. At present, China faces great inflationary pressure.

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[5]In this article, D means the first order difference sequence. Such as DJRC, DHM, DMFR, DFAI, DEDI.

Fortunately, the central bank has taken prudent monetary policy measures which helped to curb inflation and effectively reduce risk in the financial system. The excessive growth of fiscal spending indicates that central and local governments may invest too much. If the government's scale of investment expands rapidly, it will increase the government's scale of debt financing and cause an implicit debt problem. As a result, solvency risks may be passed into the financial system and increasing vulnerability.

*The negative coefficients for exports (ET), fixed assets investment (DFAI), and real estate development investment (DEDI) indicate that they are negatively correlated with the financial fragility index.*

Export shocks will affect the healthy operation of the financial system, increasing financial vulnerability. Since the beginning of the reform and opening process in 1978, China's dependence on foreign trade has increased significantly. As is well known, China operates under the environment of an export-led growth model. Thus, small movements in the international community will have a serious impact on the country's exports, though the international competitiveness of export products is limited. The impact of the international environment caused profits of export enterprises to decline; as a result, bank loans cannot be paid back in a timely manner, and at the same time credit is constrained. From the companies' points of view, they will operate with great difficulty, or even collapse, and for the banks there will be an increase in bad debts, increasing financial risk. Increased investment in fixed assets and real estate by government will reduce vulnerability in the financial system since investment in fixed assets will transfer the social capital from the virtual economy to the real economy. In terms of the real estate industry, the focus is on a large number of bank loans but because of the increase in collateral, the banks' losses caused by default risks will decrease. So it is in line with China's current economic growth model to bring macro variables into the regression model.

## 4.2 Suggestions

In consideration of the present situation regarding China's macroeconomic and financial system risk, the authors put forward the following suggestions.

First of all, the possibility of an outbreak of systemic financial risk is not high at present, but the overall risk in the financial system is increasing. This paper shows that the macro economic growth has double effects on financial system fragility and economic growth that is too fast will increase financial system vulnerability. Therefore, China urgently needs to adapt to the new normal economic development model and avoid expanding the economy too quickly.

Secondly, the implicit guarantee of government is the provision of credit in China's financial market. In China, government can intervene in the market, and investors can enter the financial market and easily assume high risk, practices which increase market risk. Therefore, it is important to reduce government intervention in the financial market and deepen financial system reform, thereby ensuring the steady development of the financial system.

In summary, the accurate measurement of financial system fragility in China has great theoretical value and practical significance, and can assist in developing effective strategies for prevention mechanisms. In this way the healthy development of China's financial system can be promoted, and the country's competitiveness in the international market and the ability to deal with adverse external shocks can be enhanced.

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