金融经济学研究

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Content

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The Construction and Application of China's Aggregate Financial Stability Index(AFSI) and Its Policy Implications

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Abstract: This paper constructs an Aggregate Financial Stability Index (AFSI) for China's financial system using the quarterly data of 2000Q1 – 2012Q3, and the AFSI is used to measure and predict the level of China's financial stability. The results of measurement show that China's financial system has experienced in general three relatively "unstable" phases: 2000 – 2001, 2005 – 2008 and 2011 – 2012, which capture well the impact and influence of major events at home and abroad such as the 9. 11 terrorist attacks, China's entry into the WTO, China's exchange rate reform, U. S. subprime crisis and the European debt crisis to the stability of China's financial system. The results of prediction show that the level of China's financial stability during 2012Q4 – 2014Q4 will probably face some downside risks.

Key words: financial stability, Aggregate Financial Stability Index (AFSI), measure, prediction

1 Introduction

The approach of aggregate index is a technique for measuring and predicting the levels of financial stability, which involves combining several basic indexes into a whole one through certain procedures or means. Since one basic index can only

reflect one aspect of the whole condition, it is necessary to establish an aggregate index to describe complex and overall situations, such as financial stability. Examples of this kind of aggregate index include "Financial Stress Index" （FSI）, （Illing and Liu, 2003[1]）, "Financial Vulnerability Index" （Nelson and Perli, 2005[2]）, "Financial Stability Condition Index" （FSCI） （Van den End, 2006[3]）, "Banking Stability Aggregate Index" （Gersl and Hermanek, 2006[4]） and "Aggregate Financial Stability Index" （AFSI）（Albulescu, 2009[5]; Morris, 2010[6]）

In recent years, Chinese scholary began to carry out research on Aggregat Index of financial stability in Chian. For instance, Pan Yangchun （2012）[7], Fang Zhaoben and Zhu Junpeng （2012）[8] established "Aggregate Financial Stability Index" （AFSI） which covered 16 basic indexes and 17 basic indexes respectively by referring to the analytical framework of Albulescu （2009）.

On the basis of the above researches, the author of this paper has created an Aggregate Financial Stability Index （AFSI） for China's financial system, and employed it to measure and predict the stability of Chinese financial market. The method features with three unique aspects. First, it builds a structural framework for stabilizing finance, and supports the basis and evidence of index establishment and application. Second, it covers 32 carefully selected basic indexes, extending to a broad range of themes, including the development, robustness and vulnerability of financial system, global economic and financial situations. Third, it quantitatively defines the boundary of financial stability, based on which it is possible to accurately identify the status （stable or instable） of financial system, and thus further develop targeted policy measures.

2 Connotation and Analytical Framework of Financial Stability

Due to its rich connotation, financial stability has not reached an agreed definition internationally①. According to the definition made in China Financial Stability Report （hereinafter referred to as report[9]） and the research of Garry J. Schinasi （2009）[10], we consider financial stability as a continuous process, in which financial system has three different conditions, i. e. , inside, near and outside boundary, respectively corresponding to three policy implications, prevention, mitigation and disposition. In conclusion, the structural framework for maintaining financial stability is shown in Figure 1.

In this paper, we first need to establish an AFSI index for Chinese financial

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① See China' Financial Stability Report 2005 for some detailed definitions.

system. The AFSI index covers four dimensions, as shown in Table 1 below. The indexes in the table address all aspects in Figure 1 required to be evaluated and monitored to maintain financial stability.

3 The Index Selection and Data Description

We supply and modify the index system created by Albulescu (2009) according to the characteristics of Chinese financial system and by referring to research results in related literatures published home and abroad. The indexes are selected on the principle of authority, representativeness, comprehensiveness and data availability. We totally select 32 basic indexes (see Table 1). The data used in this research are the quarterly data from 2000Q1 – 2012Q3.
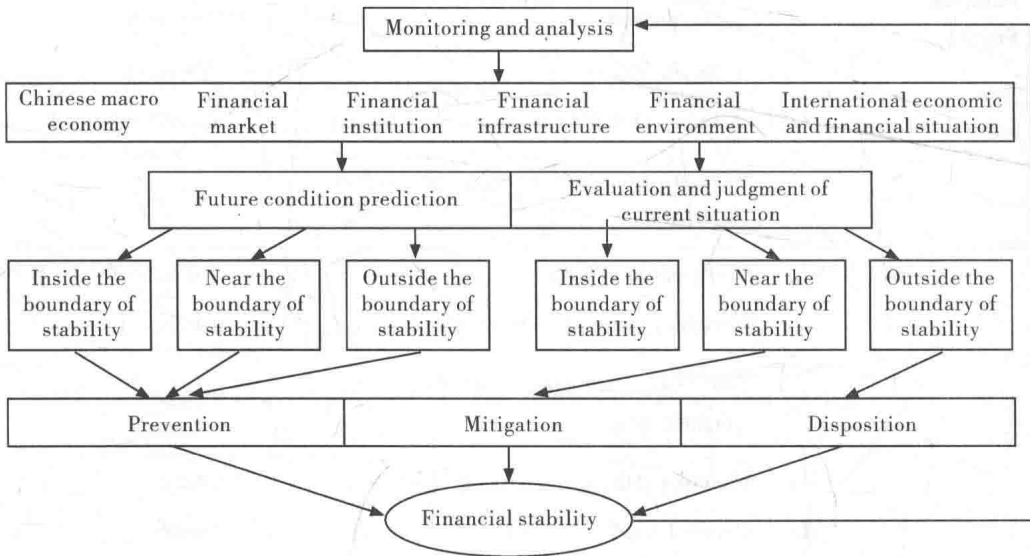
Figure 1   Structural Framework for Maintaining Financial Stability

Table 1   Basic Index in Analysis of Financial Stability

Dimension	Code	Index	Influence Direction	Basis of Selection	Data Source
Development of Financial System	I_{d1}	Total credit/GDP	+	Albulescu	1
	I_{d2}	Insurance penetration (insurance premium/GDP)	+	IMF	2
	I_{d3}	Volume of pledge-style repo	+	IMF	2

To be continued

Continued

Dimension	Code	Index	Influence direction	Basis of selection	Data source
Development of Financial System	I_{d4}	Stock value/GDP	+	Albulescu	1
	I_{d5}	Bond issue/GDP	+	IMF	2
	I_{d6}	Financial assets in bank/total financial assets	+	IMF	1
Financial Fragility	I_{v1}	Inflation rate	−	Albulescu	1
	I_{v2}	Financial deficit/GDP	−	Albulescu	1
	I_{v3}	Current account deficit/ GDP	−	Albulescu	4
	I_{v4}	Fluctuation of exchange rate	−	Albulescu	5
	I_{v5}	Loan/deposit	−	Albulescu	1
	I_{v6}	Deposit/M2	+	Albulescu	1
	I_{v7}	（Reserve fund/deposit）/（M0/M2）	+	Albulescu	1
	I_{v8}	Foreign exchange reserve/ short-term external debt	+	IMF	1，4
Financial Robustness	I_{s1}	Bad loan/total loan	−	Albulescu	6，3
	I_{s2}	Regulatory capital/ risk-weighted asset	+	Albulescu	6，3
	I_{s3}	Tier one regulatory capital/risk - weighted assets	+	Guide	6，3
	I_{s4}	Liquidity ratio	+	Guide	6，3
	I_{s5}	Return on assets	+	Guide	6，3
	I_{s6}	Return of capital	+	Guide	6，3
	I_{s7}	Difference between reference loan rate and deposit rate	−	IMF	7
	I_{s8}	Liquidity ratio of 5000 enterprises	+	Report	8
	I_{s9}	Asset-liability ratio of 5000 enterprises	−	Report	8
	I_{s10}	Real estate price index	−	Guide	2
	I_{s11}	Net disposable income of household	+	Guide	1，9
	I_{s12}	Average daily turnover in stock market	+	Guide	10

To be continued

Continued

Dimension	Code	Index	Influence Eirection	Basis of Selection	Data Source
	I_{w1}	Economic climate index-CESifo	+	Albulescu	11
	I_{w2}	World inflation	−	Albulescu	12
Global Economic	I_{w3}	World economic growth	+	Albulescu	12
and Financial	I_{w4}	International crude oil price （BRENT）	−	Report	2
Situation	I_{w5}	London interbank offered rate （LIBOR）	−	Report	13
	I_{w6}	Real effective exchange rates of dollar （AREER）	+	Report	5

Note: （1）The "influence direction" means forward direction （+） or backward direction （−） regarding the effect of index of each single item on financial stability.

（2）The code of "data source" is defined as follows: 1—economic statistics database of CEInet; 2—industry database of CEInet; 3—GTA CSMAR research database series; 4—website of State Administration of Foreign Exchange; 5—website of Bank for International Settlements （BIS）; 6—website of China Banking Regulatory Commission; 7—website of People's Bank of China; 8—quarterly report of People's Bank of China; 9—website of National Bureau of Statistics of China; 10—RESSET financial database; 11—website of CESifo; 12— international financial statistics （IFS）; 13—Wind database.

Data source: Albulescu （2009）; China Financial Stability Report （report for short）; Guide for Preparation of Financial Robustness Index （IMF, 2006[11]）（guide for short）; IMF （2011）[12] （IMF for short）.

Our financial development dimensions totally involve six indexes which reflect the developmental level of banking, bond, insurance, monetary and capital markets and other financial sectors. There are eight indexes for indicating financial fragility. They mainly show macroeconomic stability and the capital structure of bank. There are twelve indexes for finarcial soundness, which reflect the financial soundness and robustness of financial institutions and their counterparties （firms and households） of a country. At last, the global economic and financial situation involves six indexes. It should be noted that we do seasonal adjustment for all quarterly data by X12.

4 Construction of China's AFSI

4.1 The Standardization of Index Value

To combine basic indexes into an aggregate one, they must be standardized. The standardization can be realized by various means. In this paper, we use min-max means. All the index values falls within interval [0, 1] after being subjected to min-max standardization. Value "1" is the best value for each index, indicating stability, while "0" represents the opposite. The min-max standardization formula is given

below：

$$I_{it}n = \frac{I_{it} - Min(I_i)}{Max(I_i) - Min(I_i)} \qquad (1)$$

Where, $I_{it}n$ denotes standardized value of an index; I_{it} denotes the value of index i at the stage of t; $Min(I_i)$ and $Max(I_i)$ denotes the worst and the best values of index i in the period of analysis[①].

4. 2 The Weight Determination and Index Calculation

The combination of basic indexes into a composite index involves the selection of appropriate weight determination method. Unlike the methods of weighting applied by Albulescu （2009）, Morris （2010） and Pan Yangchun （2012）, the factor analysis method we use here allows classification of a number of original indexes into different sections, which can exhibit the specific meaning of each factor and enable identification of the relative significant of each factor and even each basic index.

First, we conduct KMO and Bartlett tests to judge whether an original variable is suitable for the factor analysis. The test result reveals that KMO value is 0. 754, greater than 0. 6. According to the standard established by statistician Kaiser, the value is available for factor analysis. The Bartlett sphericity test shows concomitant probability is 0. 000, lower than significance level of 0. 05, which also shows that the original variable is suitable for the factor analysis.

The factors in this paper are selected based on eigenvalue greater than 1, and six factors are obtainable in total. The cumulative variance contribution rate of the factors reaches 90. 497%, indicating that the selected common factors provide more than 90% of information about each original variable, with loss of only a small amount of information. Thus, the factor analysis offers desirable results. The variance contribution and its rate for each factor variable after rotation are given in Table 2.

Table 2 Variance Contribution and Weight of the First Six Factors after Rotation

Factor	Variance contribution	Variance contribution rate （%）	Cumulative variance contribution rate （%）	Weight of factor
1	13. 508	42. 212	42. 212	0. 466
2	4. 679	14. 621	56. 833	0. 162
3	3. 854	12. 043	68. 876	0. 133

To be continued

① As for financial stability, the maximum of positive index is the most desirable value, while the minimum is least desirable one; the case is the opposite for negative index.

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Factor	Variance contribution	Variance contribution rate （%）	Cumulative variance contribution rate （%）	Weight of factor
4	2. 492	7. 786	76. 662	0. 086
5	2. 230	6. 969	83. 631	0. 077
6	2. 197	6. 866	90. 497	0. 076

In this paper, weighting is made based on the variance contribution rate of each factor after rotation. As seen in Table 2, the first factor is given a weight of 0. 466 （42. 212/90. 497）, and the weighting for the rest is performed by this analogy. Then we get a composite score F of all AFSIs in each quarter. Higher score means stronger overall stability. The calculation equation is given below:

$$F_t = 0.466F_{1t} + 0.162F_{2t} + 0.133F_{3t} + 0.086F_{4t} + 0.077F_{5t} + 0.076F_{6t} \quad (2)$$

For the purpose of comparison, the composite score is mapped to interval $[0, 1]$ according to equation （1） to obtain the aggregate index AFSI of financial stability （Figure 2）.

Based on the load of all common factors subjected to rotation[①], we can see that the development of economy and finance plays a vital role in financial stability. Moreover, Chinese financial stability is also substantially subjected to impact of exchange rate, bank's capital adequacy ratio, liquidity, inflation, short-term external debt' real estate price and other factors.

4. 3 The Judgment and Explanation of AFSI

The judgment of financial stability level requires a criterion. We use and expand the practices of Wan Xiaoli （2008）[13] here: get AFSI gap （*AFSIGAP*） with AFSI sequence minus HP filter, and then subtract a standard deviation from the mean of *AFSIGAP* within sample period. The result is regarded as "financial instability" threshold, i. e. $TH = \mu - \sigma$, where *TH* refers to threshold, μ to the mean of *AFSIGAP* and σ to the standard deviation of *AFSIGAP*. If *AFSIGAP* is less than threshold *TH* （*AFSIGAP* – *TH* < 0）, the quarter is deemed "finical instability". In other words, 0 line is the so-called financial stability boundary, the area above the 0 line is financial stability area and that below the 0 line is financial instability area. Therefore, the financial stability of China from 2000Q1 to 2012Q3 during sample period is shown in Figure 2.

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① Space is limited, the data is available for request.
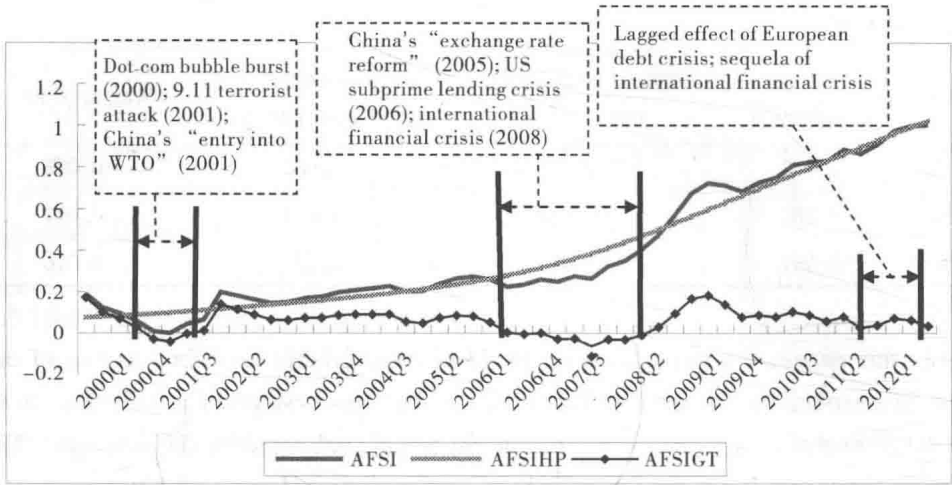
Note: AFSIGT is the difference between AFSIGAP and the threshold TH. The negative difference represents "financial instability". AFSIHP is HP filter of AFSI, showing the long-term trend of the index.

Figure 2　China's Financial Stability from 2000Q1 to 2012Q3

As shown in Figure 2, China's financial system generally experienced three relatively "instable" stages within the sample period: from 2000 to 2001, 2005 to 2008 and 2011 to 2012, which exactly capture the impact and influence of 9.11 terrorist attack, China's "entry into WTO", China's "exchange rate reform", US subprime lending crisis, European debt crisis and other significant domestic and overseas events on China's financial stability.

Although the above domestic and overseas events have exerted different impacts on China's financial stability, China's economy and finance generally maintained a healthy and stable development for Chinese authorities formulated and took effective countermeasures timely and perfected emergency plans to avoid systematic financial risks. Therefore, AFSI is generally on the rise, as shown from AFSIHP in Figure 2.

5 The Econometric Certification of China's AFSI Sensitivity

We will then conduct an econometric certification to furtherly assess the quality of the AFSI index built above and investigate the sensitivity of the index to the variations of some important macroeconomic variables. By referring to the study of Albulescu (2009) and Morris (2010), the following macroeconomic variables are selected in

the paper[①]: Interbank offer rate (*INTR*), Shanghai closing composite index (*SCCI*), Real GDP growth rate (*RGDPGR*) and Money supply growth rate (*M2R*). The data of the above four variables are all from economic statistical database of CEInet.

Before constructing models, we performed ADF stationary test on all variables. The results show that only *RGDPGR* and *M2R* are stationary sequences at 1% significance level. *AFSI*, *INTR* and *SCCI* variable sequences all have a unit root. Therefore, in order to gain an effective and precise relationship, we will use gap or difference to represent these variables. The econometric certification model is as follows:

$$AFSIGAP_t = c + \alpha AFSIGAP_{t-1} + \sum_{i=0}^{1} \beta_i DINTR_{t-i} + \sum_{i=0}^{1} \Phi_i DSCCI_{t-i}$$

$$+ \sum_{i=0}^{1} \varphi_i RGDPGR_{t-i} + \sum_{i=0}^{1} \lambda_i M2R_{t-i} + \varepsilon_t \qquad (3)$$

Variables of the current period and first order lag are selected to measure their current influence on *AFSIGAP* and their lag effect on *AFSIGAP* in the future. Only the first order lag effect is investigated in the paper since the quantity of samples in the paper is small and high lag order may reduce model freedom, thus affecting the reliability of test results. *AFSIGAP* first order lag item is added to the model for consideration of its own dynamic change. If $|\alpha| < 1$, *AFSIGAP* is of mean reversion. By Using OLS method and removing step by step insignificant variables in the model, the final regression results can be shown in Table 3.

Table 3 Metrological Certification Results

Variable		Coefficient	Std. error	t-Statistic	Prob.
C		−0.0457 *	0.0238	−1.9191	0.0615
AFSIGAP(−1)		0.6516 ***	0.0866	7.5196	0.0000
DINTR(−1)		−0.0353 ***	0.0123	−2.8729	0.0062
DSCCI(−1)		−3.55E − 05 ***	1.05E − 05	−3.3914	0.0015
M2R(−1)		0.2530 *	0.1325	1.9098	0.0627
R^2	0.7565				
Adjusted R^2	0.7344				
D. W. statistic	1.8267				
LM test(p =4)	5.2112[0.2663]				

Note: ***, ** and * represents 1%, 5% and 10% significance level respectively; [ ] represents accompanying probability P.

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① These variables are selected for they will be impacted seriously during crisis and are significantly different from those in normal period, thus facilitating AFSI prediction and warning.

Econometric verification results show that the AFSI index we constructed can respond to the variations of Shanghai Composite Index, interbank offer rate and money supply growth rate, and the coefficient symbol all is as expected. Especially, *AFSIGAP* is of mean reversion. Although the current AFSIGAP will vary consistently according to the last *AFSIGAP*, the variation range is much smaller. In addition, the four routine test values indicate that the certification result in Table 3 is good. R^2 and the adjusted R^2 are 0. 76 and 0. 73 respectively, much greater than 0. 41 obtained by Albulescu （2009） and 0. 55 by Morris （2010）. DW test and LM test also indicate that the regression model is free of serial correlation.

In a word, econometric certification results indicate that the AFSI we constructed can correctly and sensitively reflect the variations of some important macroeconomic variables in China.

6 The Prediction of China's Financial Stability

The good econometric relationship between AFSIGAP and a group of macroeconomic variables makes it possible for us to predict and assess the stability of China's financial system in the future. If we know the predicted value of model independent variables in a given period, we can predict the value of dependent variables in the same period. Therefore, we selected the predicted data provided by EIU database, the research report by Shenyin & Wanguo Securities （Liu and Yang, 2012[14]） and relevant reports from China News （Qi, 2013[15]）.
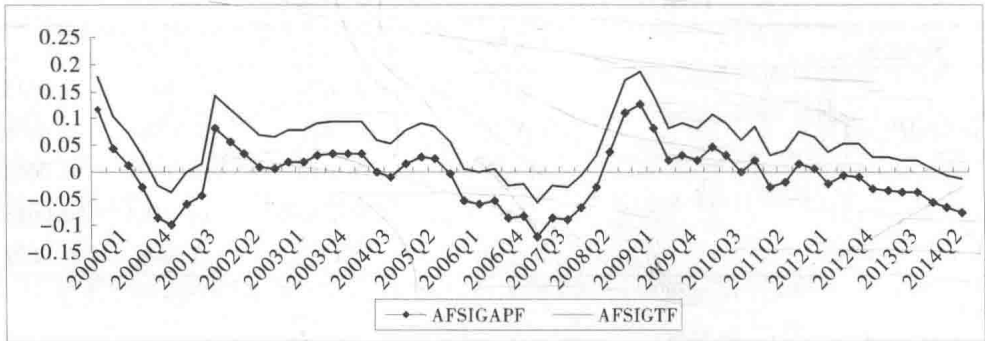
Note: AFSIGAPF represents the predicted value of AFSIGAP and AFSIGTF refers to the difference between AFSIGAPF and threshold TH.

Figure 3 AFSIGAP Stochastic Simulation Dynamic Prediction

Stochastic simulation is used in the paper to make dynamic prediction of AFSIGAP from 2012Q4 to 2014Q4. According to econometric results in Table 3, the prediction will be based on the following model:

$$AFSIGAP_t = c + \alpha * AFSIGAP_{t-1} + \beta * DINTR_{t-1} + \Phi * DSCCI_{t-1}$$
$$+ \lambda * M2R_{t-1} + \varepsilon_t \tag{4}$$

The predicted results of model (4) are shown in Figure 3 according to the predicted value of independent variables mentioned above.

Similarly, we take $TH = \mu - \sigma$ from 2000Q1 to 2014Q4 as the financial instability threshold. If $AFSIGAP$ is less than TH, the quarter shall be regarded as "financial instability". Figure 3 shows that $AFSIGAP$ from 2012Q4 to 2014Q4 will keep approaching the stability boundary and even enter into instability area in the second half of 2014 due to the lagged effect of international financial crisis, European debt crisis and other events.

7 Conclusion and Policy Suggestion

According to the results, we give the following suggestions based on the framework of Figure 1.

● Given that China's financial system will keep approaching stability boundary or may enter into instability area from 2012Q4 to 2014Q4, the authority should pay close attention to potential risks and take preventive measures.

● If the financial system keep approaching stability boundary, the authority should take relief policy measures timely to maintain financial stability.

● If the financial system enters into instability area inadvertently, the authority should take disposal measures decisively.

● The factor analysis shows that economic and financial development is critical to financial stability. Therefore, the authority should deal with the relationship among reform, development and stability properly.

● Different risk sources require different policies. To pinpoint risk sources and develop targeted policy measures, the authority should strengthen the monitoring of the indexes that are important factors affecting China's financial stability, make accurate prediction by using pre-warning system, pressure test, cross check and other methods, and accordingly take effective measures timely to prevent instability.

References

[1] Illing, M., and Liu Y., 2003. An Index of Financial Stress for Canada. National Bank of Canada, WP/14.

[2] Nelson, W. R., and R. Perli, 2005. Selected Indicators of Financial Stability. FourthJoint Central Bank Research Conference, ECB.

［3］ Van den End, J. W. , 2006. Indicator and Boundaries of Financial Stability. Nederlandsche Bank, WP/97.

［4］ Gersl, A. , and J. Hermanek, 2006. Financial Stability Indicators: Advantages and Disadvantages of their use in the Assessment of the Financial System Stability. Financial Stability Report of Czech National Bank.

［5］ Albulescu, Claudiu Tiberiu, 2009. Forecasting Romanian Financial System Stability Using a Stochastic Simulation Model, CRIEF. University of Poitiers, Working Paper.

［6］ Morris, Verlis C. , 2010. Measuring and Forecasting Financial Stability: The Composition of an Aggregate Financial Stability Index for Jamaica. Financial Stability Department Bank of Jamaica, Working Paper.

［7］ Pan, Yangchun, 2012. A Research of China's Financial System Based on Composite Stability Index. Journal of East China JiaoTong University, No. 2: 71 – 78.

［8］ Fang, Zhaoben, and Junpeng Zhu, 2012. The Estimate and Prediction of the Level of Chinese Financial Stability. Journal of Finance Forum, No. 10: 4 – 10.

［9］ Financial Stability Analysis Group of The People's Bank of China, 2005 – 2012. China Financial Stability Report, http://www. pbc. gov. cn.

［10］ Garry J. Schinasi, 2009. Financial Sstability Board of the People's Bank of China translate. Safeguarding Financial Stability: Theory and Practice, Beijing: China Financial Publishing House.

［11］ IMF. , 2006. Guide for Preparation of Financial Robustness Index. http://www. imf. org/external/pubs/ft/fsi/guide.

［12］ IMF. , 2011. People's Republic of China: Financial System Stability Assessment. IMF Country Report No. 11/321.

［13］ Wang, Xiaoli, 2008. The Judgment and Measurement of the Fragility of China's Financial System from 1987 to 2006. Journal of Financial Research, No. 6: 80 – 93.

［14］ Liu, Junwei, and Guoping Yang, 2012. Multi Factors Time Choosing Model and the ShangHai Securities Composite Index Prediction in 2013: Financial Engineering Research 5 in the Winter of 2012, ShenWan Research, December.

［15］ Zhan Qi, 2013. Stock Market Prediction in 2013: It Will Become Turning Point of China's Stock Market, http://finance. people. com. cn/stock/n, 01 – 5.