

Measurement of Systemic Financial Risk Based on Real Estate Market

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Abstract: This paper constructs a systematic financial risk index system by selecting indicators from five aspects: macroeconomic risk, stock market risk, financial institution risk, international market risk and real estate market risk, uses the entropy value method to determine the weights of the indicators and calculates the systematic financial risk index from 2007 to 2024. The results of the study show that the systemic financial risk index has a rising trend, especially in recent years. The decline in housing prices and the slowdown in macroeconomic growth result in a significant increase in systemic financial risk. This paper provides some reference for stabilizing house prices and reducing systemic financial risk.

Keywords: Real estate market, Systemic financial risk, Index system, Risk measurement.

1. Introduction

Systemic financial risk is usually defined as the risk that the whole financial system may collapse or fail to function in the face of certain shocks due to the interconnectedness and dependence of the components within the financial system. Unlike the risk of a single financial institution, systemic financial risk is characterized by complexity, contagion, suddenness and widespread harm. Once it breaks out, it will have a significant impact on the real economy and financial stability, and may even trigger a global financial crisis.

Since 2000, China's real estate industry has gained tremendous development and has become an important support for China's economic development. The direct contribution of China's real estate sector to GDP has stabilized in the 6%-7% range over the past five years (Cai, 2018). In addition, the real estate market carries a large amount of concentrated distribution of residents' wealth. Nearly 60% of Chinese residents' household wealth is concentrated in real estate, and fluctuations in housing prices directly affect residents' balance sheets. However, after the COVID-19 epidemic, economic development has slowed down, housing prices have fallen in some cities, and several real estate companies have defaulted on their debts, bringing a potential crisis to the stable development of China's financial system.

The high degree of correlation between the real estate market and the financial system also makes it one of the important sources of systemic financial risk. On the one hand, real estate development loans and home mortgage loans are an important part of bank assets; on the other hand, the real estate sector is also an important investment target for trust funds, asset securitization products and other shadow banking instruments. Price fluctuations in the real estate market may be transmitted through multiple channels in the financial market to areas such as banks, trusts, insurance and capital markets, further aggravating the vulnerability of the financial system. House prices and real estate credit are important factors affecting the stability of the economy and financial system. Therefore, it is of great significance for the stability of China's financial system to find out the mechanism of the real estate industry's impact on systemic financial risks, analyze the risks of the real estate industry and measure the

resulting systemic financial risks.

This paper studies the theoretical mechanism of systemic financial risk triggered by the real estate market, measures systemic financial risk from five subsystems, obtains the comprehensive index of systemic financial risk, and observes its trend, so as to effectively prevent and control systemic financial risk.

2. Literature Review and Mechanism Analysis

2.1. Literature Review

Indicator analysis is an important method for measuring systemic financial risk. It refers to the method of selecting different aspects of indicators and using statistical methods to synthesize them into one indicator for measuring systemic financial risk. It is an important method used by the IMF, BIS & FSB to measure the stability of the financial system and systemically important institutions. Kaminsky et al. (1998) proposed the signal analysis method based on historical data, through the construction of risk early warning indicator system and thresholds to estimate the probability of financial crisis. Hakkio and Keeton (2009) constructed the KCFSI indicator system to measure systemic financial risk in the United States and further verified the feasibility of the indicator system. Liu and Zhu (2011) established four major categories of macroeconomic indicators affecting the systemic financial risk of banks, and finally synthesized the indicator data suitable for the systemic financial risk of China's banking industry after a series of processing. Tao and Zhu (2016) selected seven market dimensions such as the financial market, stock market, etc., established a subsystem of indicators in each dimension, and utilized principal component analysis to synthesize the indicators of each dimension, and finally constructed a systematic risk indicator that can be used for local and overall analysis. Wu et al. (2018) assessed government debt risk by constructing comprehensive indicators from four dimensions, including economic development, financial capacity, debt situation, and government management.

2.2. Influencing Mechanisms of House Price on Systemic Financial Risk

The transmission of risks from the real estate market to the financial market and the triggering of financial crises can be roughly divided into the following three stages. First, it is the risk accumulation stage, which is the interaction between house prices increasing and credit expansion. In this stage, due to the prosperity of the real estate market, house prices continue to rise, while the credit policy is loose, resulting in a large amount of funds into the real estate market, the risk gradually accumulated. Second, it is the risk spillover stage, which is cross-sectoral transmission after a significant drop in house prices. When the real estate market bubble bursts, house prices fall sharply, leading to losses in real estate-related financial institutions and sectors, and risks begin to be transmitted across sectors. Finally, it is the risk contagion stage, which is contagion between financial institutions based on bilateral debt structures. On the basis of the sharp fall in house prices and cross-sectoral risk spillovers, bilateral debt relationships between financial institutions become the main channel of risk contagion, further exacerbating the volatility

of the financial system.

3. Construction of a Comprehensive Index of Systemic Financial Risk

3.1. Selection of Indicators

According to the existing literature and the main sources of financial risks in China, the indicators are selected to construct a systematic financial risks indicator system, as shown in Table 1, which includes five major subsystems, namely, macroeconomic risks, equity market risks, financial institution risks, international market risks and real estate market risks. The fourth column in the Table 1 shows the direction of the correlation between the indicator and systemic financial risks, “positive” indicates that the larger the indicator, the higher the systemic risk; “negative” indicates that the smaller the indicator, the higher the systemic risk; “interval” indicates that the indicator is optimal within a given interval, i.e., the systematic risk is minimized, and the greater the deviation from the interval, the higher the systematic risk.

Table 1. Systematic Financial Risks Indicator System

Level 1 Indicators	Level 2 Indicators	Level 3 Indicators	Direction
Systemic Financial Risks	Macroeconomic Risks	GDP growth rate (X11)	Negative
		Inflation rate (X12)	0%~5%
		Growth rate of total retail sales of consumer goods (X13)	Negative
		M2 growth rate (X14)	5%~15%
		Cumulative growth rate of investment in fixed assets (X15)	Negative
	Equity Market Risks	A-share average P/E ratio (X21)	Negative
		Shanghai Composite Index (X22)	Positive
		Growth rate of total market capitalization of Shanghai and Shenzhen stocks (X23)	Positive
		Growth rate of stock market turnover (X24)	0%~15%
	Financial Institution Risks	Loan-to-deposit ratio of financial institutions (X31)	Positive
		Growth rate of loans to financial institutions/GDP growth (X32)	Positive
		Non-performing loan ratio of commercial banks (X33)	Positive
		Banking Sector Prosperity Index (X34)	Negative
		Interbank Offered Rate (IBOR)-weighted 1-year vs. 7-day spread (X35)	Positive
	International Market Risks	Foreign direct investment growth rate (X41)	Negative
		Import and export amount month-on-month growth (X42)	Negative
		Current account balance/GDP (X43)	0%~3%
		Growth rate of foreign exchange reserves (X44)	Negative
	Real Estate Market Risks	Real estate price growth rate (X51)	Negative
		Growth rate of real estate development investment completion (X52)	Negative
		National Housing Prosperity Index (X53)	Negative
		Growth rate of sales of commercial properties (X54)	Negative

3.2. Data Processing and Weight Calculating of The Indicator System

The timeframe of the systemic financial risk indicator data is from Jan. 2007 to Oct. 2024, with a total of 214 monthly data. The data are sourced from the National Bureau of Statistics, China Banking Regulatory Commission, Shanghai Stock Exchange, etc.

The data were first pre-processed because of problems such as missing data and inconsistent frequencies. (1) The data frequency is unified into monthly. For indicators of quarterly frequency such as GDP growth rate, use the quadratic interpolation method in Eviews software to convert them to monthly data. For indicators of daily frequency such as stock

index, use the method of monthly average to convert them to monthly data. (2) Filling in missing data. Indicators such as housing prices, which are missing data for the month of January, are filled in using the averages of the first three months and the last three months.

This study employs the entropy method to determine the weights. Firstly, align the direction of the indicators and standardize the index. The original dataset is $X_{m \times n}$, m for the number of observations, n for the number of indicators. In this paper, m is 214 and n is 22.

For positive indicators, the standardization process is:

$$y_{ij} = \frac{x_{ij} - \min(x_{ij})}{\max(x_{ij}) - \min(x_{ij})} \quad (1)$$

For reverse indicators, the standardization process is:

$$y_{ij} = \frac{\max(x_{ij}) - x_{ij}}{\max(x_{ij}) - \min(x_{ij})} \quad (2)$$

$$w_j = \frac{1 - E_j}{\sum_{j=1}^n (1 - E_j)} \quad (6)$$

For the interval type indicator, the optimal interval is assumed to be [a, b] and the standardization process is:

$$y_{ij} = \begin{cases} 1 - \frac{a - x_{ij}}{\max(a - \min(x_{ij}), \max(x_{ij}) - b)}, & x_{ij} < a \\ 1 - \frac{x_{ij} - b}{\max(a - \min(x_{ij}), \max(x_{ij}) - b)}, & x_{ij} > b \\ 1, & a \leq x_{ij} \leq b \end{cases} \quad (3)$$

Secondly, the weights of the indicators are calculated using the matrix $Y_{m \times n}$.

The proportion of the i th sample under the j th indicator:

$$p_{ij} = \frac{y_{ij}}{\sum_{i=1}^m y_{ij}} \quad (4)$$

Information entropy of the j th indicator:

$$E_j = -\frac{1}{\ln m} \sum_{i=1}^m (p_{ij} \ln p_{ij}) \quad (5)$$

Where $E_j \in [0, 1]$. $p_{ij} \ln p_{ij} = 0$ when $p_{ij} = 0$.

Weights of the j th indicator under the entropy method:

3.3. Systemic Financial Risk Measurement Results

The entropy method is used to calculate the weight of each indicator and the weights are shown in Table 2.

Table 2. Systemic financial risk composite index weights

X1	w	X2	w	X3	w
x11	0.0422	x21	0.0423	x31	0.0454
x12	0.0435	x22	0.0442	x32	0.0437
x13	0.0425	x23	0.0427	x33	0.0495
x14	0.0428	x24	0.0426	x34	0.0444
x15	0.0439			x35	0.0424
X4	w	X5	w		
x41	0.0423	x51	0.0436		
x42	0.0425	x52	0.0435		
x43	0.0429	x53	0.0436		
x44	0.0430	x54	0.0428		

The systemic financial risk index is calculated as follows:

$$F_i = \sum_{j=1}^{22} (w_j x_{ij}) \quad (i=1, 2, \dots, m) \quad (7)$$

Where i denotes the month and j denotes the indicator. Based on this formula the monthly systemic financial risk index value can be calculated. In addition, the index value for each secondary indicator can be calculated. The total systemic financial risk index is shown in Figure 1.

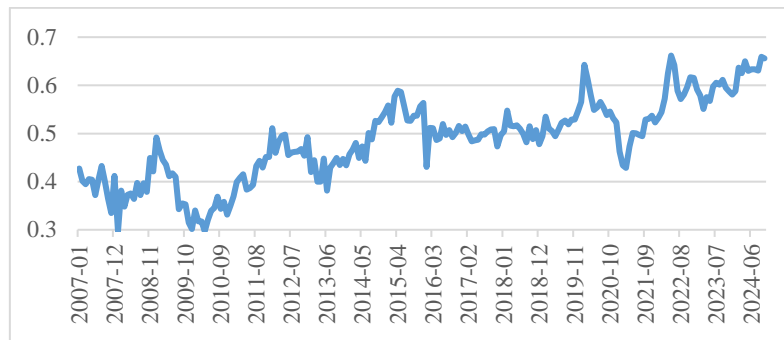


Figure 1. Systemic Financial Risk Index

Between 2007 and 2009, systemic financial risks began to rise, showing positive fluctuations. In 2007, the collapse of the United States real estate market triggered the subprime mortgage crisis, which significantly raised the level of uncertainty and risk faced by China's financial institutions in both their international and domestic operations, contributing to a significant increase in the risk level of the entire financial institution system. After the global financial crisis, China adopted proactive fiscal policy, loosed monetary policy, and increased support for various economic entities. The 'four trillion' investment stimulating program launched by the government had effectively alleviated the country's financial constraints, resulting in a clear downward trend in systemic financial risk.

Between 2009 and 2012, the large-scale fiscal stimulus program and loose monetary policy in the early period led to a sharp expansion in the scale of debt in the banking sector and a significant increase in the macroeconomic leverage

ratio. The shock to banks' credit funding led to a rise in the proportion of default loans, which in turn exacerbated the extent of systemic financial risk in banks.

During the period from 2012 to 2014, the systemic financial risk index gradually levelled off and even experienced a short-term decline. This was attributable to the government's fine-tuned regulation of macroeconomic operations, which ensured that the economy operated within a stable range. Meanwhile, by building a comprehensive financial regulatory framework and strengthening the internal management of financial institutions, the financial system's resilience to internal and external shocks has been enhanced, effectively curbing and mitigating systemic financial risks, and gradually realizing stable control of risks.

In 2015, the withdrawal of leveraged funds from the stock market triggered a severe stock market crash, resulting in the stock market experiencing sharp fluctuations, while banking systemic risks rose significantly. In addition, the rapid

development of fintech in recent years, especially the continued advancement of digitalisation and asset-light models, has become one of the factors exacerbating systemic financial risks, which involves risks arising from data, information and cybersecurity.

From 2016 to 2019, China's overall economic operation remained stable. The economic structure continued to be improved, and the regional layout became more reasonable, which promoted the innovative development of the financial market, and enhanced the ability and level of financial services to the real economy. During this period, the systemic financial risks of banks have been mitigated to a certain extent.

At the end of 2019, the sudden outbreak of the COVID-19 epidemic resulted the downtrend of the world economy, with all economies suffering a severe blow and systemic financial risks intensifying. However, in the second half of 2020, thanks to the concerted efforts of all sectors in China, the country achieved a full resumption of work and production, and the economy rebounded rapidly, demonstrating strong growth potential, while at the same time, the systemic risk of banks eased compared with the early stage of the epidemic.

Starting in 2021, the long-term impact of the COVID-19 epidemic began to emerge. Some industries, especially the manufacturing and service sectors, were severely hit, leading to a decline in corporate profitability and a tightening of capital chains. Against this backdrop, industrial debt defaults increased. The risk of loan defaults of some industries and enterprises hard hit by the epidemic has been gradually exposed, leading to a rise in the non-performing loan ratio of banks and posing a threat to the stability of the banking system. In particular, the fall in property prices in recent years has led to the shrinkage of residents' wealth, which in turn affects their consumption ability and willingness to consume. The reduction in consumption may lead to a decline in aggregate social demand, which will have a negative impact on economic growth and thus increase systemic financial risks. On the other hand, it has led to a decline in sales of real estate enterprises, a tight capital chain and even the risk of bankruptcy. This will increase the risk of loan defaults by real estate enterprises and reduce their financing capacity, further aggravating systemic financial risks.

4. Conclusion

In this paper, five aspects of indicators including the real estate market are selected to construct a comprehensive system of systemic financial risk indicators based on the real estate market, and the weights of the indicators are determined by entropy method. The systemic financial risk indicators from January 2007 to October 2024 are calculated. The results show that the systemic financial risk has a rising

trend in recent years, especially after the COVID-19 epidemic. The slow economic growth and the fall of house prices have brought a huge impact on the systemic financial risk.

In this regard, this paper puts forward the following suggestions. First, the establishment of real estate market risk early warning mechanism is the key to prevent systemic financial risks. The government should strengthen the monitoring the operation of the real estate market, timely detect and give early warning of potential risks. A risk response mechanism and contingency plans should be established to ensure that measures can be taken quickly and effectively to respond to risks when they occur. Second, banks should strengthen the management of credit policies, strictly review the conditions for the issuance of real estate loans, and prevent market bubbles caused by excessive credit. Risk assessment of loans to real estate buyers and developers should be conducted to ensure the safety of loan. Third, real estate enterprises should be encouraged and supported to raise funds through issuing bonds, equity financing, trusts and other means to broaden financing channels, reduce financing costs and improve market stability.

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