

## Research On China's Real Estate Financial Risk Early Warning-Taking Zhejiang Province As An Example

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**ABSTRACT:**Real estate finance has played a pivotal role in promoting the development of the Chinese real estate market in recent years. However, the real estate market is over-reliant on real estate finance, which makes real estate finance face greater risks. This paper uses the general methods and principles established by the financial risk early warning system to design and construct the real estate financial risk early warning system. Taking Zhejiang Province as an example, it makes an empirical analysis on real estate financial risk. The study found that the proportion of real estate investment in Zhejiang's fixed investment structure has been normal since 2011. Developers can quickly adjust the real estate development area according to current housing price trends and related policies. Although the interest rate is lower, the cost of real estate financing has been increasing in recent years as the risk of private capital investment increases and the investment yield declines, which also led to an increase in real estate financial risks. In order to reduce the risk of real estate finance, the government should maintain a low interest rate level and improve the housing affordability of residents. Meanwhile, it should expand the financing channels of the real estate industry through the establishment of real estate investment trust funds, increasing international investment and guiding the proportion of real estate investment to remain at a reasonable level.

**KEYWORDS:** Zhejiang Province, Real Estate, Financial Risk, Early Warning

**JEL Classification:** R23, R31

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### I. INTRODUCTION

The real estate industry is a capital-intensive industry. Its development is inseparable from the financial support of the financial system. However, the trading behaviors of the market entities can easily lead to abnormal fluctuations in real estate prices. In addition, the financial industry is inherently vulnerable. The combination of the two markets will make the problem more complicated: abnormal fluctuations in real estate prices will distort asset prices, dislocation of financial resources, instability of the financial system, and even more likely will lead to the break of the bank's capital chain and a financial systemic crisis.

Since the second half of 2014, the sales volume of China's real estate market has shown a declining trend. In 2014, real estate sales have shown negative growth throughout the year, and the growth rate of real estate development funds has also declined. In particular, the growth rate in March decreased by 18.1% compared with February (Figure 1). After the sales contracted for 4 months, housing prices in the country began to show a significant decline. After that, there was a trend of ups and downs. The uncertainty of market expectations led to a clear wait-and-see phenomenon. In some areas, housing prices had even fallen sharply. Some buyers abandon the house to escape loans. The phenomenon was particularly evident in Zhejiang Province where the author lived.

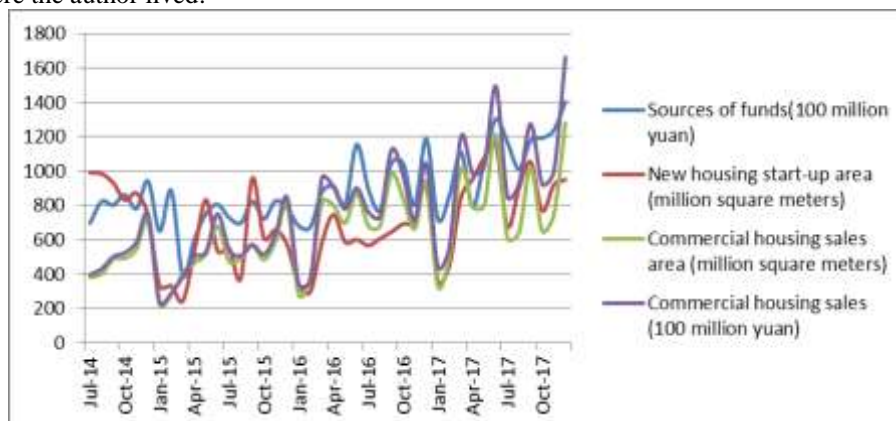


Figure 1 Changes in real estate sales and development funding sources in 2014

This paper aims to study the real estate financial risk early warning system of Zhejiang Province in the light of financial security and related literature. The real estate financial risk early warning research is an early warning based on the real estate related industry and the trend of national and local economic development, and is not limited to the internal analysis of the real estate market. This article will take Zhejiang Province as an example, comprehensively consider the basic economic situation, the operation status and risk degree of the financial industry of Zhejiang Province. Then select corresponding multi-level, guiding and easy-to-operate early warning indicators, so as to comprehensively test the real estate financial risks. According to the relevant indicators setting principles set by international standards and the threshold value determination method of financial risk early warning indicators, and based on financial innovation, financial risks and changing characteristics, the critical values and regions of each indicator are revised. Finally, combined with indicator data, indicator interval and critical value and index weight, the network neural model is used to predict the data, and the prediction results are analyzed.

## **II. LITERATURE REVIEW**

### **2.1 Excessive financial support is the internal basis of risk generation**

Moderate financial support can be a lubricant for the development of the real estate industry, but excessive financial support can easily lead to fast rising in real estate prices, and even lead to asset price bubbles. Many scholars believe that the relationship between finance and real estate is getting closer and closer. It is precisely because of the excessive support of credit funds with commercial banks as the main channel that the housing prices continue to soar and the risks are accumulating Xu Guangyuan et al, 2016<sup>[1]</sup>; Fang Yi, 2016<sup>[2]</sup>; Lopes-Espinosa G et al, 2013<sup>[3]</sup>. Chen Qiong and Yang Shenggang (2009)<sup>[4]</sup> found that long-term low interest rates especially short-term interest rates below the Taylor's rule benchmark which increased the fragility of the financial system. Qu and Liu (2015)<sup>[5]</sup> also show that it is the bank's risk-taking that has a procyclical affects which leads to increasing systemic risks including the real estate market.

### **2.2 The banking system crisis caused by real estate risks**

Gadanez B and Jayaram K (2010)<sup>[6]</sup> believes that when the economic fundamentals are not good, the changes in liquidity expectations of the lender's banks in the market will cause the initial impact to have a significant negative impact on the banks. Nimantha P and Manamperi A (2017)<sup>[7]</sup> further studied the effects of banking crisis caused by economic fundamentals, information asymmetry and incomplete market structure.

### **2.3 Prevention and resolution of real estate financial risks**

Some scholars have studied regional financial risk issues from the perspective of real estate market risk. The most mainstream view is to establish a real estate market bubble and risk warning system. Zhai Wenxiu et al (2017)<sup>[8]</sup>, Liu Jinquan (2016)<sup>[9]</sup>, Zhang Wei (2016)<sup>[10]</sup>, Ouyang Yuanfen and Webber and Willison (2011)<sup>[11]</sup>, Xu Dilong and Chen Shuanglian (2015)<sup>[12]</sup> have conducted an early warning analysis of real estate conditions in relevant regions by synthesizing a new indicator. Shen Yue et al (2017)<sup>[13]</sup>, Illing M and Liu Y (2016)<sup>[14]</sup>, Korinek A (2009)<sup>[15]</sup>, Bianconi M and Yoshino J(2015)<sup>[16]</sup> explored the method system of real estate bubble early warning, and used this to judge the real estate operation status.

It can be seen that China's economic early warning mechanism is based on China's basic national conditions and draws on the early warning mechanism established by the research methods above. The development of this mechanism has shifted from qualitative research analysis to quantitative and qualitative analysis, and the research field has expanded from special to comprehensive, but its development is far from mature and still in the early stages of the transformation of early warning systems. In particular, the research on economic early warning system is mostly based on the macroeconomic field, and rarely appears in the micro real estate field. This paper will apply the early warning system research to the prediction of real estate financial risk. It selects the indicators of real estate financial risks in Zhejiang Province, and then establishes an early warning model for empirical analysis, and finally draws conclusions.

## **III. PRINCIPAL SOURCES OF REAL ESTATE FINANCIAL RISKS IN ZHEJIANG PROVINCE**

### **3.1 Private lending**

Zhejiang is a province with very active private capital, and the relationship between real estate and financial lending is also very close. The interest on private lending is much higher than that of banks, and the more active private lending, the faster the interest on borrowing will be. All real estate developers have to raise the housing prices to repay their loans. For example, when the housing prices in Wenzhou (a city in Zhejiang Province) continued to be falling for more than 30 months from 2012 to 2015, many private financial companies faced bankruptcy.

### **3.2 Bank**

A large part of the investment in real estate business projects comes from bank loans, and part of the total investment capital that construction companies need to pay in advance is also from bank loans. In addition, during the purchase of a house, most of the funds are derived from the personal loan business provided by the

bank. It can be seen that the most important source of funds in the development chain of the real estate industry is bank. When the construction companies and individuals are unable to repay the loans, the banks will also face a large number of non-performing loans.

### 3.3 Macroeconomic policy

In the overall structure of national economic development, the real estate industry occupies a large proportion. The most intuitive manifestation of overheated economic development is the over-investment in the real estate industry. Therefore, in order to stabilize economic development, the state will put real estate on the focus of macroeconomic regulation. When the new macro-control policies are implemented, some real estate enterprises will experience the suspension of work and even the phenomenon of asset freeze or corporate bankruptcy. This has also led to difficulties in capital operation in the real estate industry and increased financial risks in the real estate industry.

### 3.4 Financial System

The real estate problem in Zhejiang Province is mainly caused by the manufacturing crisis and the imperfect financial system. Only by perfecting the financial system and promoting the financial industry to make progress in the industry, so that the manufacturing industry can recover rapidly and successfully transform and upgrade, can we solve the current real estate financial dilemma in Zhejiang Province.

## IV. DESIGN OF EARLY WARNING SYSTEM OF REAL ESTATE FINANCIAL RISK

### 4.1 Selection of indicators

(1) Total investment in real estate development / total investment in fixed assets of the whole society (  $X_1$  )

This indicator can explain the proportion of private lending and bank loan funds to real estate. Only when the proportion of each part of the investment is kept within a reasonable range, can the resources be used most effectively.

(2) Average price of real estate sales/per capita monthly disposable income (  $X_2$  )

At present, the source of funds for many residents in China to buy a house is bank loans. Therefore, if the mortgage monthly contribution is greater than the per capita monthly disposable income of the resident, the real estate price is too high, and there may be asset bubble in the house price.

(3) Total construction area of the house / total area of completed buildings (  $X_3$  )

This indicator affects the supply of housing to a certain extent. According to some data, if the indicator is greater than 4.0, the housing supply will exceed demand, while if it is less than 3.0, there will be a shortage of supply.

(4) Interest rate (  $X_4$  )

Too high bank interest rates will reduce bank loans in the real estate market and turn to private lending, while interest rates are determined by national policies. In addition, the increase in loan interest rates, the repayment pressure of real estate developers who have already loaned will increase, easily leading to the default of the repayments, and the bank has a large number of non-performing loans.

### 4.2 Determination of critical points and division of regions

Dividing the economic fluctuations into several different levels is the division of the status of the early warning indicators. The critical point is the junction point from one level to another.

(1) Regional division

It is divided into five areas, namely "too cold", "cold", "normal", "hot" and "overheated", and the signal lights are "red light" and "yellow light", "Green light (usually as a stable zone)", "light blue light", "blue light".

(2) Determination of the critical point of a single indicator

The determination of the critical point of a single indicator is very important and needs to be relatively precise. It will be divided by the method of  $3\sigma$  next.

## V. EMPIRICAL ANALYSIS OF EARLY WARNING SYSTEM OF REAL ESTATE FINANCIAL RISK

### 5.1 Sample data

Based on the indicators selected above, the model construction of this paper requires the following data (Table 1).

**Table 1** Relevant data of Zhejiang real estate in 2008-2017

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Fixed assets investment (100 million dollars)	1412.58	1627.62	1875.19	2149.28	2674.15	3148.81	3676.17	4139.89	4587.28	4716.06
Real estate investment (100 million dollars)	306.53	341.55	458.39	626.85	791.85	941.85	1100.36	1077.56	1131.72	1246.48

Building construction area (Ten thousand square meters)	19273.30	1993.270	2378.190	29927.39	3342.297	37647.24	42144.35	41687.33	41609.78	41236.20
Housing completion area (Ten thousand square meters)	4458.30	3843.80	4115.80	4528.59	4292.94	4692.34	6390.17	5892.86	7925.40	6884.20
Commercial housing sales area (Ten thousand square meters)	2992.20	5538.13	4816.53	3531.36	4005.29	4886.99	4676.83	5985.30	8636.79	9599.67
Average selling price (dollars / square meter)	948.78	1185.75	1402.72	1490.61	1612.51	1673.03	1594.84	1594.69	1685.00	1947.66
Per capita disposable income of urban residents (dollars)	3443.48	3728.93	4145.30	4692.57	5234.84	5618.18	6120.15	6623.33	7157.12	7766.82
One-year time deposit rate (%)	3.87	2.25	2.50	3.00	3.25	3.00	2.75	1.75	1.50	1.50

Source: China Statistical Yearbook and Zhejiang Statistical Yearbook.

## 5.2 Data Processing

### (1) Indicator $X_1$

Table 2 is the Indicator  $X_1$  obtained from the real estate development investment and the whole society fixed asset investment data from 2008 to 2017 in Zhejiang Province.

**Table 2** The proportion of real estate development investment in the fixed assets investment of the whole society in 2008-2017 in Zhejiang

	Real estate investment (100 million dollars)	Fixed assets investment (100 million dollars)	$X_1$
2008	306.53	1412.57	0.22
2009	341.55	1627.62	0.21
2010	458.39	1875.15	0.24
2011	626.85	2149.28	0.29
2012	791.85	2674.15	0.30
2013	941.85	3148.81	0.30
2014	1100.36	3676.17	0.30
2015	1077.56	4139.89	0.26
2016	1131.72	4587.28	0.25
2017	1246.48	4716.06	0.26

### (2) Indicator $X_2$

Table 3 is the Indicator  $X_2$  based on the average price of real estate sales and the per capita monthly disposable income of urban residents in Zhejiang Province from 2008 to 2017.

**Table 3** Average real estate sales price/per capita monthly disposable income in 2008-2017

	Average selling price(dollars/square meter)	Per capita disposable income of urban residents (dollars/month)	$X_2$
2008	948.78	286.95	3.31
2009	1185.75	310.74	3.82
2010	1402.72	345.44	4.06
2011	1490.61	391.04	3.81
2012	1612.51	436.23	3.70

2013	1673.03	468.18	3.57
2014	1594.84	510.01	3.13
2015	1594.69	551.94	2.89
2016	1685.00	596.42	2.83
2017	1947.66	647.23	3.01

(2) Indicator  $X3$

Table 4 is the Indicator  $X3$  obtained from the data of housing construction area and housing completion data of Zhejiang Province from 2008 to 2017.

**Table 4** Total housing construction area / total area of completed buildings in 2008-2017

	Building construction area (Ten thousand square meters)	Housing completion area (Ten thousand square meters)	$X3$
2008	19273.30	4458.30	4.32
2009	19932.70	3843.80	5.19
2010	23781.90	4115.80	5.78
2011	29927.39	4528.59	6.61
2012	33422.97	4292.94	7.79
2013	37647.24	4692.34	8.02
2014	42144.35	6390.17	6.60
2015	41687.33	5892.86	7.07
2016	41609.78	7925.40	5.25
2017	41236.20	6884.20	5.99

**5.3 Determination of the early warning sector and division interval**

Next, we will use the  $3\sigma$  method to divide the early warning and early warning division. According to the principle of the  $3\sigma$  method, the probability of deviating from  $1\sigma$  or more is the largest, and the probability of deviating from  $3\sigma$  or more is the smallest. If the deviation is  $1\sigma$  or more as the abnormal interval, the abnormality interval is large, and the data request is too strict. If we select  $3\sigma$  or more as the abnormal interval, most of the data is non-anomalous. Therefore, the following will deviate from the central axis by more than  $2\sigma$  as a standard for data anomalies. So we can divide the warning domain into the following table.

**Table 5** Classification table of early warning domains

Status	T	C	N	H	O
Interval	$\leq x - 2\sigma$	$(x - 2\sigma, x - \sigma)$	$(x - \sigma, x + \sigma)$	$(x + \sigma, x + 2\sigma)$	$\geq x + 2\sigma$

From Tables 1 to 4, the average ( $\bar{x}$ ) and standard deviation ( $\sigma$ ) of each indicator can be calculated, as shown in Table 6.

**Table 6** The average ( $\bar{x}$ ) and standard deviation ( $\sigma$ ) of each indicator

	$X1$	$X2$	$X3$	$X4$
$\bar{X}$	0.26	3.46	6.29	2.65
$\sigma$	0.04	0.44	1.25	0.74

Using the  $3\sigma$  method, we can divide the early warning indicators into the following intervals, as shown in Table 7.

**Table 7** Intervals of each early warning indicator

	too cold	cold	normal	hot	overheated
$X1$	$\leq 0.2032$	$(0.2032, 0.2455)$	$(0.2455, 0.3301)$	$(0.3301, 0.3724)$	$\geq 0.3724$
$X2$	$\leq 2.9443$	$(2.9443, 5.2855)$	$(5.2855, 9.9679)$	$(9.9679, 12.3091)$	$\geq 12.3091$
$X3$	$\leq 2.1642$	$(2.1642, 4.8549)$	$(4.8549, 10.2363)$	$(10.2363, 12.927)$	$\geq 12.927$
$X4$	$\leq 1.9215$	$(1.9215, 2.4013)$	$(2.4013, 3.3609)$	$(3.3609, 3.8407)$	$\geq 3.8407$

Table 7 can determine the status of various early warning indicators from 2008 to 2017, as shown in Table 8.

**Table 8** Status of various indicators from 2008 to 2017

	$X1$	$X2$	$X3$	$X4$
2008	cold	cold	cold	overheated
2009	cold	cold	normal	cold
2010	cold	cold	normal	normal
2011	normal	cold	normal	normal

2012	normal	cold	normal	normal
2013	normal	cold	normal	normal
2014	normal	cold	normal	normal
2015	normal	too cold	normal	too cold
2016	normal	too cold	normal	too cold
2017	normal	cold	normal	too cold

**5.4 Prediction of various early warning indicators**

(1) Establish a neural network model

In the MATLAB software, the input matrix is constructed separately. The following data are the four early warning indicator data sets from 2008 to 2017.

P1= [0.26 0.26 0.29; 0.26 0.29 0.30; 0.29 0.30 0.29; 0.30 0.29 0.39; 0.29 0.39 0.29; 0.39 0.29 0.25];

P2= [4.45 4.9 7.1; 4.9 7.1 9.44; 7.1 9.44 9.64; 9.44 9.64 11.27; 9.64 11.27 8.92; 11.27 8.92 7.18];

P3= [5.54 4.64 4.02; 4.64 4.02 6.80; 4.02 6.80 8.19; 6.80 8.19 7.73; 8.19 7.73 10.78; 7.73 10.78 11.56];

P4= [2.52 2.79 3.87; 2.79 3.87 2.25; 3.87 2.25 2.50; 2.25 2.50 3.00; 2.50 3.00 3.25; 3.00 3.25 3.00];

The Target matrix is constructed separately. The following data is the four early warning indicator data of 2017. Then create network, set parameters, and train.

T1= [0.26 0.25 0.26];

T2= [2.89 2.83 3.01];

T3= [7.07 5.25 5.99];

T4= [1.75 1.50 1.50];

The predicted results of each indicator value in 2018 are:

X1 = 2.6231429e - 01

X2 = 2.9482405e - 00

X3 = 5.6507904e + 00

X4 = 1.5500000e + 00

**Table 9** Prediction results of each indicator value in 2018

	X1	X2	X3	X4
Warning value	0.26	2.94	5.65	1.55
Status	normal	cold	normal	too cold

(2) Comprehensive indicator warning

Through the calculation of the early warning status and weight of each of the above indicators, the comprehensive early warning index of each year is analyzed and calculated, and finally the trend chart of real estate financial risk is drawn.

① Division of warning interval

For the setting of the warning status of each early warning indicator, refer to the data value of Table 8 and obtain Table 10.

**Table 10** Interval score situation

Status	too cold	cold	normal	hot	overheated
Score	1	2	3	4	5

② Calculation of comprehensive early warning index

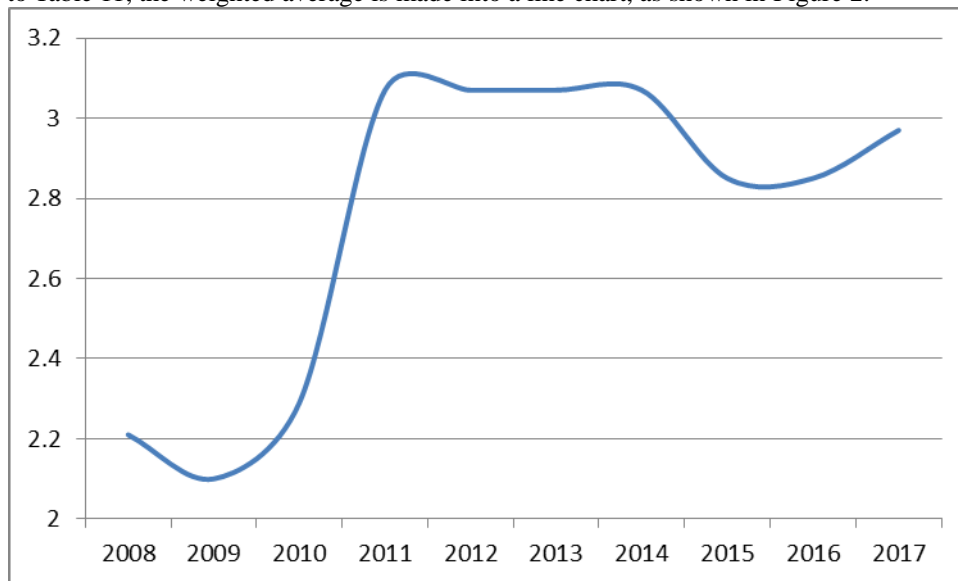
The comprehensive early warning index and weighted average of real estate financial risks for 2008-2017 are calculated in accordance with Table 10, as shown in Table 11 below.

**Table 11** Comprehensive warning index for each year

	X1	X2	X3	X4	Weighted average
2008	2	2	2	5	2.21
2009	2	2	3	2	2.10
2010	2	2	3	3	2.29
2011	3	2	3	3	3.07
2012	3	2	3	3	3.07
2013	3	2	3	3	3.07
2014	3	2	3	3	3.07
2015	3	1	3	1	2.85
2016	3	1	3	1	2.85
2017	3	2	3	1	2.97



According to Table 11, the weighted average is made into a line chart, as shown in Figure 2.



**Figure 2** Trends of the comprehensive early warning index from 2008 to 2017

As can be seen from Figure 3, the real estate financial risk in Zhejiang was on the rise from 2009 to 2011, and it had also begun to decline with the cooling of the real estate market from 2011 to 2015. However, it has been increasing with the warming of the real estate market after 2015.

③ warning signal settings

Based on the early warning indicators of the above years, we can draw the general trend of real estate financial risk warning. According to the status classification of the early warning indicator and the determination of the critical point, we can set the corresponding warning standard score interval and attach the corresponding warning signal.

**Table 12** Comprehensive index early warning score interval and signal lights

	too cold	cold	normal	hot	overheated
score interval	$\leq 1.5$	(1.5,2.5)	(2.5,3.5)	(3.5,4.5)	$\geq 4.5$
signal light	Blue	light blue	green	yellow	red

Blue light: There is a big problem in the development of real estate. The government can encourage the development of the real estate industry through policy intervention.

Light blue light: The real estate is in a cold situation at this time. It may become colder, as well as become better.

Green light: The real estate market is in a normal situation.

Yellow light: Real estate development began to deviate from normal and prospered. Investment in real estate is increasing and exceeding normal targets.

Red light: Real estate development is too fast, and the government has introduced policies such as purchase restrictions to limit property investment.

**Table 13** Comprehensive indicator warning light for each year

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Weighted average	2.21	2.10	2.29	3.07	3.07	3.07	3.07	2.85	2.85	2.97
Early warning status	cold	cold	cold	normal	normal	normal	normal	normal	normal	normal
Signal light	light blue	light blue	light blue	green	green	green	green	green	green	green

It can be seen from Table 13 that the real estate financial risk in Zhejiang Province tends to be normal after 2011, but it should not be overlooked that the risk has been rising with the warming of the real estate market in recent years.

**5.5 Analysis of prediction results**

According to Tables 14 and 9 to draw Table 14, we can conduct an early warning status analysis of the predicted values of Zhejiang Province in 2018.

**Table 14** Forecast results and warning status of Real Estate Zhejiang Province in 2018

	X1	X2	X3	X4	Comprehensive indicator
Forecast warning value	0.26	2.94	5.65	1.55	3.09
Early warning status	normal	normal	normal	cold	normal
Signal light	green	green	green	light blue	green

(1) X1 will be in normal status in 2018. If the investment in real estate development is relatively small, it will lead to the waste of monetary resources. Because the money is unevenly distributed, the proportion of real estate investment in the entire fixed investment structure will be unreasonable, and the development of the real estate market is not healthy. It can be seen from the status of the indicator from 2008 to 2017 that the indicator has been in normal status except for the colder indicator in 2008-2010. In other words, the investment was in a reasonable range except for the relatively small amount of real estate investment in 2008-2010.

(2) X2 will be in normal range in 2018. Zhejiang's private capital investment is not booming In recent years. The financing method of dismantling the East Wall to supplement the Western Wall has greatly increased the financing cost. The increase in financing costs has led to a decline in the investment in real estate, and the rate of purchase will also decrease. Once house prices fall, it will reduce the profitability of real estate companies and the ability to repay bank loans will decline which may cause the bank's non-performing loans to increase and lead to an increase in financial risks.

(3) X3 will be in normal status in 2018, which reflects the area of real estate construction and the area of real estate completion in a very suitable and stable situation in Zhejiang Province. This shows that the developer has a very keen sense of the real estate industry and can quickly adjust the real estate development area according to the current housing price trend and related policies.

(4) X4 will be in the cold area in 2018. If the interest rate is too high, it will make the real estate industry difficult to finance. In particular, China's real estate industry has a single financing channel, mostly relying on banks, so the real estate industry is very sensitive to interest rates. The high interest rates are important factors in real estate financial risks. Meanwhile, excessive interest rates will also reduce the purchasing power of buyers, resulting in a decline in sales of commercial housing, so real estate companies will not be able to withdraw funds.

## VI. POLICY SUGGESTIONS

(1) Take measures to prevent the decline in the proportion of real estate investment. It is possible to expand the financing channels and reduce the financing costs of the real estate industry by establishing real estate investment trusts or increasing international investment. At the same time, the government should also establish sound regulations and policies to ensure the stable operation of real estate trust funds and prevent financial risks to stabilize the financial system. .

(2) Take measures to improve the housing affordability of residents. By establishing and improving the housing provident fund system, the government can enhance the housing affordability of some families, stimulate the real rigid demand and maintain the house price at a reasonable level.

(3) Maintain a low interest rate level. Lower interest rates not only help to reduce the financing costs of real estate companies, but also reduce the cost of house buyers and increase their housing affordability, thereby reducing the real estate financial risks caused by defaults of real estate investors and developers. In addition, real estate financial risks can be dispersed through reasonable channels and innovative real estate financial products.

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