Analysis of the National Real Estate Market Risk Management under the National Macro-Control Policy—Take Jinan as an Example

Shijiang Guo*, Dong Wang, Linghong Zeng

Peking University, Beijing 100871, China. E-mail: guoshijiang1987@163.com

Abstract: In recent years, the real estate market regulation and control policies have been issued intensively, and the regulatory means have been more focused on “implementing policies according to the city”. On the whole, the important position of real estate as the pillar of our national economy has not changed, but many new characteristics have been derived from the industry. In this article, the real estate market in Jinan from 2010 to 2019 is selected, and the risk assessment and management of real estate market in Jinan City are analyzed by using the method of quantitative and qualitative risk assessment. Combined with the results of risk assessment, corresponding management countermeasures are put forward, which has certain practical significance.

Keywords: National Macro Policy; Real Estate Market; Risk Assessment

1. Introduction

The real estate industry involves many economic fields and industries, such as land, finance, construction, raw materials and so on. It has great influence on the economy and is the basic and leading industry of the national economy. With the change of macro environment, the policy of real estate regulation is tightening, the land supply is expanding, the demographic dividend is disappearing, the relationship between supply and demand is improving, and the turning point of house price may come quietly. At the same time, the long-term “irrational prosperity” of the real estate market also causes us to worry about the impact of real estate price fluctuation on related industries, financial system and even macro departments. This article analyzes the current situation of China’s real estate industry fundamentals and policies, and with the help of various risk factors affecting the real estate market, on the basis of existing domestic and foreign relevant literature, combined with the characteristics of real estate development risk in Jinan city, from the analysis of real estate market risk factors to the identification of key risk factors, and then to the formulation of risk prevention countermeasures. This article expounds the real estate risk in Jinan. Starting from the four risk factors of political risk, economic risk, market risk and natural risk, this article expounds the risk of real estate market in detail. On this basis, it makes effective analysis on the systematic risk factors of real estate, and determines the systematic risk evaluation index system of Jinan real estate market[1] according to the construction principles and procedures of risk evaluation index system.

2. Risk analysis method

To evaluate the risk of real estate market is to identify the possibility and severity of various losses in the real es-
tate market. Generally, qualitative evaluation method, quantitative evaluation method, and the combination of qualitative and quantitative evaluation method\(^2\) can be adopted.

### 2.1 Qualitative evaluation method

Qualitative evaluation method is a kind of multi-objective decision-making method. It breaks through the limitation of traditional quantitative analysis and opens up a new way for making more reasonable decisions. Delphi method is the most representative method in qualitative evaluation methods. This method is widely representative and can reliably carry out targeted risk assessment and prevention. However, due to the difficulty in selecting appropriate experts, it may also lead to hasty risk assessment conclusions.

### 2.2 Quantitative evaluation method

Quantitative analysis is to assign a certain value to each risk element and loss level. When all factors of risk measurement are assigned, the process and results of risk assessment can be quantified. The main evaluation methods include internal standard method and internal evaluation method.

### 2.3 Qualitative and quantitative evaluation method

Qualitative or quantitative methods can not effectively and accurately assess the risk, quantitative methods are usually too strict, and qualitative methods are too fuzzy. Therefore, it is necessary to carry out risk assessment on the basis of quantitative and qualitative methods. The commonly used qualitative and quantitative methods are AHP and fuzzy comprehensive evaluation.

Firstly, according to the nature of multi-objective decision-making and the general objectives, the concepts considered are analyzed, and their mutual relations, logical attributes and importance levels are arranged hierarchically to construct a hierarchical structure from top to bottom. Secondly, in the hierarchical structure model, the decision-makers make a score according to the specific situation and actual requirements by comparing the two factors. Finally, after the judgment matrix is obtained, the ranking and consistency test\(^3\) are carried out according to the following formula.

\[
AW = \lambda_{\text{max}} W
\]

\[
CI = \frac{\lambda_{\text{max}} - n}{n - 1}
\]

\[
CR = \frac{CI}{RI}
\]

A is the judgment matrix, \(\lambda_{\text{max}}\) is the maximum eigenvalue of A, W is the corresponding eigenvector, which is actually the weight of each factor. The RI value is shown in Table 2 below.

**Table 1. Scale of judgment matrix**

| Scale | Meaning |
|-------|---------|
| 1     | Compared with the two factors, the importance is the same |
| 3     | Compared with the two factors, one factor is slightly more important than the other, and the difference is 1-2 |
| 5     | Compared with the two factors, one factor is more important than the other, with a difference of 3-4 |
| 7     | Compared with the two factors, one factor is more important than the other, with a difference of 4-6 |
| 9     | Compared with the two factors, one factor is more important than the other, with a difference of 7-8 |
| 2, 4, 6, 8, reciprocal | The median value of the above adjacency |

**Table 2. RI values of judgment matrix of order 1-9**

| n  | 1   | 2   | 3   | 4   | 5   | 6   | 7   |
|----|-----|-----|-----|-----|-----|-----|-----|
| RI | 0   | 0   | 0.58| 0.9 | 1.12| 1.24| 1.32|
When \( Cr \leq 0.1 \), it is considered that the results of hierarchical total ranking have satisfactory consistency, so the weight coefficient of \( w \) as each factor can be obtained. If \( Cr \geq 0.1 \), adjust the matrix again. After getting the eigenvector of each judgment matrix, the weight of each layer for the top element is calculated from top to bottom according to the weight of each layer.

Fuzzy comprehensive evaluation method is to make a comprehensive evaluation of something by using fuzzy mathematics tools under the influence of many factors. First of all, the index system of evaluation is determined, which index and aspect are used to evaluate the objective object, i.e. \( u = (u_1, u_2, ..., u_m) \). Secondly, the evaluation set \( V = (V_1, V_2, ..., V_m) \) is determined to obtain the fuzzy evaluation direction and establish the fuzzy matrix, which is the basis of fuzzy comprehensive evaluation\(^2\).

\[
R = \begin{bmatrix}
R_{11} & R_{12} & \cdots & R_{1m} \\
R_{21} & R_{22} & \cdots & R_{2m} \\
\vdots & \vdots & \ddots & \vdots \\
R_{m1} & R_{m2} & \cdots & R_{mm}
\end{bmatrix}
\]

Among them, \( R_{ij} \) is the subordinate relationship of factor \( u_i \) corresponding to \( V_j \) in \( U \), that is, the \( I \) th single factor evaluation of the matter, which constitutes the basis of comprehensive evaluation. Thus, the basic model of fuzzy comprehensive evaluation \( B = a \) can be obtained \( \circ R \). The fuzzy relationship \( a \) between the evaluation factors and the evaluated things is formed through the fuzzy matrix, and then the evaluation results can be analyzed.

3. Risk classification of real estate market

3.1 Policy risks

Real estate macro policy is an important means to maintain economic development and industrial health in China. In recent years, the state has issued a large number of regulation and control measures for the real estate industry at the policy level, which has played a positive role in the stability of the real estate market, but there are also risks associated with them. The risks are mainly divided into the following categories\(^3\).

3.1.1 Political risk

The loss caused by political events to the whole real estate market is the so-called political risk, which is a small probability event, but the consequences are immeasurable, which will directly bring a series of direct and indirect losses.

3.1.2 Risks of market economic system reform

Market financial system is the basis of national economic structure and market operation. If there is a change, the corresponding industry pattern will change, which is the reform of market economic system.

3.1.3 Risk of industrial policy change

The change of industry policy is the change of internal order, which leads to the change of supply and demand relationship of industry products, which will also be the risk hidden danger of real estate market. In China, there are strict restrictions on the government’s regulation and control of land and finance, including the government’s policy of regulating and controlling the development of land and finance, especially in the industries of China.

3.1.4 Risk of land management system change

The monopoly supply of land market led by the government also causes the structural shortage of land supply, especially the insufficient supply of residential land in the first and second tier cities, which leads to the rigid rise of land price and the emergence of real estate bubble. However, based on the land market expectation, the land hoarding behavior of some real estate developers will interfere with the government’s land regulation. At the same time, due to the long cycle of industry construction, the change of real estate supply quantity has obvious time lag, and is restricted by the psychological expectation of real estate buyers. The change of government land transfer quantity is also difficult to change the supply-demand relationship of real estate market in the short term.

3.1.5 Housing system change risk
The government has changed the target direction of housing investment management and housing system, which has greatly disturbed the real estate market, which is the housing system risk.

### 3.1.6 Risk of financial policy change

As a capital intensive industry, both the demand side and the supply side of real estate rely heavily on external financing, especially bank credit. The change of monetary policy means that the real estate industry financing environment changes, which will have a great impact on the real estate system risk.

### 3.1.7 Risk of environmental policy change

The whole process of real estate involves environmental problems. With the development of society and the improvement of life quality, the environmental requirements of the city for the industry will also change, which will lead to the increase of real estate development costs. In order to reduce costs, developers will increase the pace of development, and then lead to the quality and safety of the whole market out of control.

### 3.1.8 Risk of changes in regional development planning

The planning risk of regional development means that the change of the development degree of the city and region will affect the value of the products that have been built, are in progress and will soon start construction, which will directly cause the risk of the operating value of the real estate market. The impact of urban planning on real estate is reflected in the risk of capacity, the risk of building planning area and the related use risk.

### 3.2 Economic risk

Economic risk refers to the risk that can not continue to maintain the solvency of an enterprise in the case of poor capital chain and financial situation. Economic risks in the real estate sector include the following:

#### 3.2.1 Interest rate change risk

Real estate development funds are obtained through different channels of financing, so they have to bear capitalized interest, which should be deducted from the expected income, and the expected income is uncertain, so the real estate market needs to bear this part of risk. The impact of interest rate floating on the market is the risk of interest rate floating.

#### 3.2.2 Fund realization risk

When trading, due to the time and means of realization, the real estate commodity can not be converted into currency or the behavior of prolonging the time is the risk caused by capital realization.

#### 3.2.3 Risk of tax rate change

In the process of real estate, the tax rate has changed, and the change on cost and profit is the so-called risk of tax rate change. Its deepening reflects the transformation of regional finance and system, which may not be drastic, but the impact caused by the change risk is greater.

#### 3.2.4 Inflation risk

Inflation is a kind of normal performance, but the degree is different. However, too large fluctuation will certainly bring harm to the economy and complement inflation. Therefore, inflation risk is a very risky factor.

### 3.3 Market risk

The real estate market fluctuates up and down with the national macro policies. Due to the real estate supply and demand relationship, residents’ purchasing power, construction products and other factors, the real estate market will be directly affected.

#### 3.3.1 Supply and demand risk

When the real estate product is over capacity, the process is prolonged due to enough consumers, which leads to the long capital chain and easy to break, which is the supply side risk. Generally speaking, demand includes potential, actual and effective, one is desire which can not be realized, and the other is that there is actual consumption capacity. Therefore, we should take both of them into consideration and consider whether they can be transformed.

#### 3.3.2 Purchasing power risk

Purchasing power risk mainly refers to the default risk caused by the buyer’s inability to bear the property cost.
3.3.3 Product replacement risk

According to the change of the times, people have changed the demand for house type, so it will produce certain scale risk.

3.4 Natural risk

Due to the uncontrollability of natural conditions, the harm to the real estate market is called natural risk. The probability is small, but the harm is great. The natural risk includes the following types:

3.4.1 Fire risk

Although the fire rarely occurs, the consequences are very bad. After the accident, the consumption of the follow-up process of the product is very large.

3.4.2 Storm risk

Rainstorms and other weather are often accompanied by landslides and debris flows, which will do harm to buildings, which will bring huge losses to the real estate market.

3.4.3 Risk of temperature change

Extreme weather brings direct or indirect harm to buildings, which is a potential risk. In recent years, weather anomalies occur frequently, which are difficult to predict and cause great losses.

4. Real estate market risk assessment

Real estate risk can be divided into qualitative and quantitative methods. Qualitative analysis is based on the relevant experience and theory of real estate developers to directly identify risk factors. Through the analysis of various factors of risk, it is a method to determine the objectivity of risk and qualitative evaluation of the size of risk and its development trend. Quantitative analysis uses modern mathematical methods to process and sort out the existing data and establish a mathematical model to further reveal the regular relationship between the variables, so as to predict the risk in the system. Taking the real estate market of Jinan as an example, this article constructs the risk assessment model of real estate market from four aspects of policy risk, economic risk, market risk and natural risk, and divides the target level of real estate risk in Jinan into the following three levels. The structure hierarchy model is shown in the figure below.

![Figure 1. Risk structure model of real estate market.](image-url)
4.1 Establishment of risk evaluation index system

We take the real estate market of Jinan City from 2010 to 2019 as the sample. Limited by the conditions, we conduct a questionnaire survey on a certain number of experts, so as to determine the judgment matrix based on the survey score. The description of the impact of different levels of risk factors on the purpose we are concerned about is called the risk assessment set, which is divided into five levels\(^{[4]}\) according to the volatility of factors on the market, as shown in Table 3.

At the same time, the influence degree and risk frequency of risk factors on the market are comprehensively divided, and the real estate risk heat map is established, as shown in Figure 2.

One indicates that the risk frequency is low and the intensity is small, and the amount of risk is small; two is that the risk frequency is high but the risk intensity is small; three and four indicate that the risk frequency is low but the risk intensity is high, and the risk amount is large; five is that the risk frequency is high and the risk intensity is large. In order to meet the requirements of judgment matrix scale in analytic hierarchy process, the risk factors can be ranked, and the construction market risk heat map is established, as shown in Figure 3.

### Table 3. Risk assessment table

| Grade | 0 | 1 | 2 | 3 | 4 | 5 |
|-------|---|---|---|---|---|---|
| evaluate | No risk | Low risk | Low risk | General risk | Higher risk | high-risk |
| V | V0 | V1 | V2 | V3 | V4 | V5 |

![Figure 2. Risk heat map of real estate market](image)

### 4.1.1 Establish risk assessment judgment matrix

According to the heat map of real estate risk, market risk is higher than economic risk, economic risk is higher than policy risk, policy risk is higher than political risk, and policy risk is higher than natural risk. According to expert evaluation and judgment matrix scale, the first-class factor judgment matrix is established as shown in Table 4.

### Table 4. First level (a-b) judgment matrix

| W | Policy risk | economic risks | Market risk | Natural risk |
|---|-------------|----------------|-------------|--------------|
| W\(_1\) | 1 | 3/2 | 2 | 1/2 |
| W\(_2\) | 2/3 | 1 | 4/3 | 1/3 |
| W\(_3\) | 1/2 | 3/4 | 1 | 1/4 |
| W\(_4\) | 2 | 3 | 4 | 1 |
After establishing the first-order factor judgment matrix, the first level factors are industrial policy risk W11, land management system change risk W12, housing system change risk W13, financial policy change risk W14, environmental protection policy change risk W15, regional planning change risk W16, financing risk W21, interest rate change risk W22, capital realization risk W23, tax rate change risk W24, inflation risk W25, supply risk W31 and demand wind risk W32, purchasing power risk W33, housing scale change risk W34, fire risk W41, storm risk W42, temperature change risk W43 establish the secondary judgment matrix.

Among the factors of land policy change, institutional change, institutional risk, institutional change, institutional change are the most important risk factors. The judgment matrix of secondary factors is shown in Table 5.

Among the economic risk factors, tax rate risk is the largest, followed by interest rate risk, capital realization risk, inflation risk and financing risk. The judgment matrix of secondary factors is shown in Table 6.

Table 5. Secondary (B-C) judgment matrix (1)

| W1         | Industrial policy | Risk of land management system change W12 | Housing system change risk W13 | Risk of financial policy change W14 | Risk of environmental policy change W15 | Regional planning change risk W16 |
|------------|------------------|------------------------------------------|-------------------------------|-------------------------------------|----------------------------------------|---------------------------------|
| Industrial policy risk W11 | 1 | 1/2 | 1/4 | 1/3 | 7/6 | 5/6 |
| Land management system W12 | 2 | 1 | 1/2 | 3/4 | 1/3 | 5/4 |
| Changes in housing system W13 | 4 | 2 | 1 | 4/3 | 4 | 2 |
| Risk of financial policy change W14 | 3 | 4/3 | 3/4 | 1 | 3 | 2 |
| Risk of environmental policy change W15 | 6/7 | 3 | 1/4 | 1/3 | 1 | 1/2 |
| Regional planning change risk W16 | 6/5 | 4/5 | 1/2 | 1/2 | 2 | 1 |

Table 6. Secondary (B-C) judgment matrix (2)

| W2 | Financing risk W21 | Risk of interest rate change W22 | Capital realization risk w23 | Risk of tax rate change W24 | Inflation risk W25 |
|----|-------------------|----------------------------------|-------------------------------|-----------------------------|-------------------|
| Financing risk W21 | 1 | 3 | 2 | 3 | 3/2 |
| Risk of interest rate change W22 | 1/3 | 1 | 4/5 | 6/5 | 3/5 |
| Capital realization risk w13 | 1/2 | 5/4 | 1 | 6/4 | 3/4 |
Table 6. (Continued).
.xlsx
| Risk of tax rate change w13 | 1/3 | 5/6 | 4/6 | 1    | 1/2 |
| Inflation risk W25 | 2/3 | 5/3 | 4/3 | 2    | 1   |

Among the market risk factors, the risk of housing scale change is the largest, followed by purchasing power risk, supply risk and demand risk. The judgment matrix of secondary factors is shown in Table 7.

Table 7. Secondary (B-C) judgment matrix (3)
.xlsx
| W3 | Supply risk W31 | Demand risk W32 | Purchasing power risk W33 | W34 housing scale change risk |
|---|---|---|---|---|
| Supply risk W31 | 1 | 2/3 | 4/3 | 5/3 |
| Demand risk W32 | 3/2 | 1 | 2 | 5/2 |
| Purchasing power risk W33 | 3/4 | 1/2 | 1 | 6/4 |
| W34 housing scale change risk | 3/5 | 2/5 | 4/6 | 1 |

Among the natural risks, fire risk is the largest, followed by storm risk and temperature change risk.

Table 8. Secondary (B-C) judgment matrix (4)
.xlsx
| W4 | Fire risk w41 | Storm risk W42 | Temperature change risk w43 |
|---|---|---|---|
| Fire risk W41 | 1 | 2/3 | 1/3 |
| Storm risk W42 | 3/2 | 1 | 1/2 |
| Risk of temperature change W34 | 3 | 2 | 1 |

4.1.2 Calculate the weight of each factor

In order to facilitate the calculation, the Yaahp analytic hierarchy process software developed by Beijing Xingshengyun Software Technology Co., Ltd. is selected to calculate the real estate market risk judgment matrix of Jinan City[2]. The maximum eigenvalue and consistency of calculation are shown in Table 9 below. As the calculation Cr is less than 0.1, it is considered that the total ranking results of hierarchy have satisfactory consistency. The first and second level weight results are shown in the figure below.

Table 9. Calculation results of each factor judgment matrix
.xlsx
| Judgment matrix | Maximum eigenvalue | CI | CR | weight |
|---|---|---|---|---|
| Primary factor | $\lambda_{max}=4.000$ | 0.000 | 0.000 | W(0.240,0.1601,0.120,0.120,0.480) |
| Policy risk | $\lambda_{max}=6.466$ | 0.093 | 0.074 | W1(0.0696,0.1246,0.2494,0.1688,0.1407,0.2469) |
| economic risks | $\lambda_{max}=5.004$ | 0.010 | 0.0008 | W2(0.3551,0.1320,0.1710.1140,0.2279) |
| market risk | $\lambda_{max}=4.004$ | 0.0016 | 0.0018 | W3(0.2591,0.3886,0.2036,0.1487) |
| Natural risk | $\lambda_{max}=3.000$ | 0.000 | 0.000 | W4(0.1818,0.5455,0.2727) |
4.1.3 Establishing fuzzy matrix of risk factors

In order to get the final evaluation result of the treasury fund risk, the fuzzy comprehensive evaluation is needed to quantify the factors after obtaining the judgment matrix. According to the calculation steps of fuzzy comprehensive evaluation, the calculation is carried out step by step.

\[ W = (\text{policy risk}, \text{economic risk}, \text{market risk}, \text{natural risk}) \], and each subset is as follows:

\[ W_1 = (\text{industrial policy change risk}, \text{land management system change risk}, \text{housing system change risk}, \text{environmental protection policy change risk}, \text{regional planning change risk}, \text{financial policy change risk}) \];

\[ W_2 = (\text{financing risk}, \text{inflation risk}, \text{capital realization risk}, \text{interest rate change risk}, \text{tax rate change risk}) \];

\[ W_3 = (\text{demand risk}, \text{supply risk}, \text{purchasing power risk}, \text{housing scale change risk}) \];

\[ W_4 = (\text{fire risk}, \text{temperature change risk}, \text{storm risk}) \];

Combined with the real estate market of Jinan City from 2010 to 2019, a reasonable questionnaire is set up to evaluate the risk of the first and second level factors, and the fuzzy matrix of each subset is calculated, as shown in the table below.

**Table 10. Policy risk (R1) fuzzy matrix**

| Fuzzy evaluation                      | No risk | V 0 | Low risk | V 1 | Low risk | V 2 | General | V 3 | Higher risk | V 4 | high-risk | V 5 |
|-------------------------------------|---------|-----|----------|-----|----------|-----|---------|-----|-------------|-----|-----------|-----|
| Industrial policy changes           | 0       | 0.1 | 0.3      | 0.1 | 0.3      | 0.1 | 0.2     |     |             |     |          |     |
| Land management system changes      | 0       | 0   | 0.1      | 0.2 | 0.4      | 0.3 |         |     |             |     |          |     |
| Changes in housing system changes   | 0       | 0   | 0        | 0.1 | 0.4      | 0.5 |         |     |             |     |          |     |
| Environmental policy changes        | 0       | 0.1 | 0.3      | 0.3 | 0.2      | 0.1 |         |     |             |     |          |     |
Table 10. (Continued).

Regional planning changes

|                | V 1 | V 2 | V 3 | V 4 | V 5 |
|----------------|-----|-----|-----|-----|-----|
| Changes in financial policy | 0   | 0   | 0.1 | 0.4 | 0.2 |

Table 11. Economic risk (R2) fuzzy matrix

| Grade                      | No risk V 0 | Low risk V 1 | Low risk V 2 | Low risk V 3 | General risk V 4 | Higher risk V 5 | high-risk V 6 |
|---------------------------|-------------|--------------|--------------|--------------|------------------|-----------------|--------------|
| Financing risk            | 0           | 0.1          | 0.1          | 0.2          | 0.2              | 0.4             |              |
| Inflation risk            | 0           | 0.1          | 0.1          | 0.3          | 0.3              | 0.2             |              |
| Capital realization risk  | 0           | 0.1          | 0.1          | 0.2          | 0.3              | 0.3             |              |
| Risk of interest rate change | 0         | 0.1          | 0.3          | 0.3          | 0.2              | 0.1             |              |
| Risk of tax rate change   | 0           | 0.1          | 0.1          | 0.3          | 0.3              | 0.2             |              |

Table 12. Market risk (R3) fuzzy matrix

| Fuzzy evaluation          | No risk V 0 | Low risk V 1 | Low risk V 2 | Low risk V 3 | General risk V 4 | Higher risk V 5 | high-risk V 6 |
|---------------------------|-------------|--------------|--------------|--------------|------------------|-----------------|--------------|
| Demand risk               | 0           | 0            | 0            | 0.2          | 0.4              | 0.4             |              |
| Supply risk               | 0           | 0            | 0            | 0.2          | 0.4              | 0.4             |              |
| Purchasing power risk     | 0           | 0            | 0.1          | 0.1          | 0.3              | 0.5             |              |
| Housing scale change risk | 0           | 0            | 0.2          | 0.4          | 0.2              | 0.2             |              |

Table 13. Natural risk (R4) fuzzy matrix

| Fuzzy evaluation          | No risk V 0 | Low risk V 1 | Low risk V 2 | Low risk V 3 | General risk V 4 | Higher risk V 5 | high-risk V 6 |
|---------------------------|-------------|--------------|--------------|--------------|------------------|-----------------|--------------|
| Fire risk                 | 0           | 0            | 0.2          | 0.6          | 0.2              | 0               |              |
| Temperature change risk   | 0           | 0.5          | 0.3          | 0.2          | 0                | 0               |              |
| Storm risk                | 0           | 0            | 0.2          | 0.4          | 0.2              | 0.2             |              |

4.1.4 Fuzzy comprehensive evaluation

After the judgment matrix and fuzzy matrix of each risk factor are obtained, the first level risk factor and the second level risk factor can be comprehensively evaluated[5].

Second level fuzzy comprehensive evaluation
Policy risk factor $B_1 = \mathbf{w}_1 \circ R_1$

$$= (0.066,0.1246,0.2494,0.1688,0.1407,0.2469) \circ\frac{1}{0.30645}$$

$= (0.06605,0.16495,0.2202,0.30645,0.24226)$

In the calculation result, 0.30645 is the comprehensive evaluation value of policy risk. According to the risk heat map, the evaluation factor is V4, which is higher risk. Economic risk factor $B_2 = \mathbf{w}_2 \circ R_2$
From 2010 to 2019, under the new situation of the implementation of macro-control policies by the state, the real estate market in Jinan is operating well as a whole, which has made positive contributions to urban construction and sustainable economic and social development. However, there are also a series of problems in the real estate market in Jinan, such as the extremely unbalanced performance of land supply, the rapid rise of house prices, the excessive financial leverage and other issues, which lead to the real estate market from the fundamental risks continue to increase. This article analyzes the real estate market risk by combining qualitative and quantitative methods. With the support of data theory, it is proved that economic risk and market risk are the most important part of the systematic risk of Jinan real estate market, which is basically consistent with the actual situation of Jinan real estate.

4.2 Analysis of evaluation results

In the calculation results, 0.28992 is the comprehensive evaluation value of economic risk. According to the risk heat map, the evaluation factor is V5, which is high risk.

Market risk $B_m = w_3 \cdot R_3$

$= (0.2591,0.3886,0.2036,0.1487)^\circ \begin{bmatrix} 0 & 0 & 0 & 0.2 & 0.2 & 0.4 \\ 0 & 0 & 0 & 0.2 & 0.2 & 0.4 \\ 0 & 0 & 1 & 0.1 & 0.1 & 0.3 \\ 0 & 0 & 2 & 0.4 & 0.2 & 0.2 \end{bmatrix}$

$= (0.0,0.0501,0.20938,0.3499,0.39062)$

In the calculation results, 0.39062 is the comprehensive evaluation value of natural risk. According to the risk heat map, the evaluation factor is V5, which is high risk.

Natural risk $B_n = w_4 \cdot R_4$

$= (0.1818,0.5455,0.2727)^\circ \begin{bmatrix} 0 & 0 & 0 & 0.2 & 0.6 & 0.2 \\ 0 & 0.5 & 0.3 & 0.2 & 0 & 0 \\ 0 & 0 & 0.2 & 0.4 & 0.2 & 0.2 \end{bmatrix}$

$= (0.2727,0.21819,0.25454,0.16362,0.0909)$

In the calculation results, 0.27275 is the comprehensive evaluation value of natural risk. According to the risk heat map, the evaluation factor is V1, which is a low risk.

According to the two-level fuzzy matrix, the establishment of the first-order fuzzy matrix is as follows:

$R = \begin{bmatrix} W_1 \\ W_2 \\ W_3 \\ W_4 \end{bmatrix} = \begin{bmatrix} 0 & 0.06605 & 0.16495 & 0.2202 & 0.30645 & 0.4024226 \\ 0 & 0 & 0.1228 & 0.24739 & 0.23989 & 0.28992 \\ 0 & 0 & 0.0501 & 0.20938 & 0.3499 & 0.39062 \\ 0 & 0.27275 & 0.21819 & 0.25454 & 0.16362 & 0.0909 \end{bmatrix}$

Therefore, the real estate market risk of Jinan is calculated as follows:

$B = W \cdot R$

$= (0.240,0.1601,0.120,0.480)^\circ \begin{bmatrix} 0 & 0.06605 & 0.16495 & 0.2202 & 0.30645 & 0.4024226 \\ 0 & 0.1 & 0.1228 & 0.24739 & 0.23989 & 0.28992 \\ 0 & 0 & 0.0501 & 0.20938 & 0.3499 & 0.39062 \\ 0 & 0.27275 & 0.21819 & 0.25454 & 0.16362 & 0.0909 \end{bmatrix}$

$= (0.0.1628,0.1699,0.2398,0.2325,0.1950)$

In the calculation results, 0.2398 is the comprehensive evaluation value of real estate risk in Jinan City. According to the risk heat map, the evaluation factor is V3, which is the general risk. Therefore, the real estate risk level of Jinan is general risk.
5. Risk management countermeasures

5.1 Improve the land long-term mechanism of real estate regulation

As the provincial capital city, Jinan City should strictly implement the spiritual requirements of the Central Committee, the provincial party committee and the provincial government, earnestly base on the actual situation of Jinan real estate market, gradually establish and improve the long-term mechanism of real estate regulation and control, and make efforts from the allocation of land supply, control of land use ratio, setting of land auction price, etc., to curb the real estate bubble and realize the long-term, stable and healthy development of the real estate market.

5.2 Improve the long-term financial mechanism of real estate regulation

We should firmly adhere to the bottom line of land acquisition by developers’ own funds, resolutely prevent developers from borrowing from multiple accounts, seriously manage housing mortgage loans, and earnestly establish a sound and safe financial link between the government, banks, real estate enterprises and house buyers, prevent the occurrence of financial risks, and ensure the long-term, stable and healthy development of the real estate market.

5.3 Improve the long-term tax mechanism of real estate regulation

Gradually form a differential tax rate system with high-end containment, middle end encouragement and low-end guarantee, and timely levy property tax or property tax and land value-added tax. Jinan City should further promote the high-quality development of Jinan metropolitan area integration, Jinan will be built into an innovation driven cooperation zone, an industrial coordinated development zone, a comprehensive transportation hub area, a green ecological co preservation zone, an open international zone, a smart city construction zone and a happy life metropolitan area. From a broader perspective, it is necessary to integrate into the comprehensive experimental zone of Shandong new and old kinetic energy conversion, accelerate the upgrading and transformation of Jinan’s industry, gradually step out of the tax source transition, rely on “land finance”, and form a healthy and benign development pattern.

6. Perfect long-term housing rental system

We should improve the government’s public rental housing system, cultivate the commercial housing rental market, timely build public rental housing as the main body, gradually integrate public rental housing with low rent housing and low rent housing, implement long-term leasing, construction and purchase to prepare for the construction of public rental housing, establish a public rental housing operation system, and further improve the long-term mechanism of housing rental system, ensure the stability and health of Jinan real estate market.

References

1. Wang Y. Research on systematic risk of real estate market (in Chinese) [Master’s thesis]. Shenyang: Shenyang Jianzhu University; 2015.
2. Saaty TL. Analytic hierarchy process. Beijing: China Coal Industry Publishing House; 1988.
3. Ren Z, Xia L, Xiong C, et al. Real estate cycle. Beijing: Beijing People’s publishing house; 2017.
4. Shen F. The layer order analytic method and its application to engineering technological decision. Journal of Fuzhou University (Natural Sciences Edition) 1986; (2): 101–108.
5. Wu B. Fuzzy mathematics and its economic analysis (in Chinese). Beijing: Standards Press of China; 1994.