2018 Citi Financial Innovation Application Competition

Risk control model description report

Title ： Li Jin--A REITs platform for securitization of housing lease assets

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abstract

This document is a risk control model description report. The model described in this report is one of the core of this project and is an important part of the project risk assessment system. This part of the model is embedded in the risk control of the enterprise.

The platform establishes an environmental risk index through crawler technology, realizes real-time monitoring and forecasting of the business operation status, and realizes the prediction of financial risk of the enterprise through the revised Z-score model and KMV model.

REITs have matured to maturity in Europe and the United States and have fully demonstrated their strong liquidity, diversified portfolio risk and strong anti-inflation capabilities. However, due to the imperfect financial laws and regulations in China, the financial market is not perfect, and there is still much room for development in the Chineseization of the REITs model. On the road of China's REITs model, monitoring the operational risks of basic assets is not only the key to ensuring the normal operation of the fund, but also important for maintaining national financial security and promoting financial prosperity. The platform uses a combination of original financial risk analysis and non-financial risk analysis, including the revised Z-score model, the revised KMV model and the environmental risk control supported by the crawler technology. The monitoring of corporate risks ensures the operation of the fund.

This report is mainly divided into five parts. The first part briefly analyzes the source of risk of this project. The second part briefly describes the use of the indicators in the financial statements to obtain the financial risk status of the enterprise in the traditional sense. The company submits the financial statements at the agreed time to submit to our analysis to form the cross-sectional data and default risk of the financial risk index. Time series data for the index. The third part introduces the real-time dynamic monitoring of the surrounding environment of the enterprise by using crawler technology, so as to assist the forecast of the future operation of the enterprise.

Combined with the cross-sectional data in the financial analysis and the time series data in the non-financial analysis, we can get one. The group reflects the panel data of the enterprise risk and realizes detailed monitoring of the enterprise. In the fourth part, we take Vanke's apartment as an example to show the whole process of enterprise risk monitoring. The fifth part summarizes the entire risk control.

Contents

1. Part one: Analysis of risk sources

1.1 Risks associated with underlying assets

(1) Risk fluctuation of basic asset operating income

The cash flow of the underlying assets of the special plan is mainly composed of the rent formed by the lease of the property assets held by the project company. During the duration of the special plan, if the property asset leasing party refuses to perform the lease or default, the market price of the rent drops significantly, or other factors other than force majeure cause the property to be unable to operate normally, the project company may be The cash flow generated by the lease of property assets has an adverse impact, which causes the cash flow of the special plan to fluctuate.

(2) Risk of fluctuations in the sale price of property assets

The fund manager (on behalf of the interests of the private equity fund) may dispose of the property assets themselves or the interests of the project company holding the property assets by way of sale. As the fair value of the property assets may be affected by the degree of prosperity of the real estate market at that time, the selling price is uncertain. Sex, or because the property assets cannot be sold at fair value, thus affecting the size of the cash flow obtained by the special plan, which in turn leads to the investment income of the special plan share holders and even the investment principal loss.

1.2 Risks related to the subject

(1) Special plan operation risk and account management risk

In the operation of the special plan, the manager's knowledge, experience, judgment, decision-making, skills, etc. will affect its access to information and judgments on the economic situation and financial market price trends, such as the manager's judgment or the incomplete information. , may affect the level of income of the special program. During the duration of the special plan, the investment management, fund transfer, asset allocation and other matters in the special plan account depend on mutual supervision and cooperation between the administrator and the custodian. Once there

is coordination error or the breach of the manager or custodian, This leads to risks in the management of the special program account, which in turn affects the security and stability of the special plan assets.

(2) The manager, custodian, fund manager and fund custodian are responsible for the performance risk

The normal operation of the special plan depends on the due diligence services of the participating parties such as the administrator, the custodian, the fund manager and the fund custodian. There are risks of breach of contract by the administrator, risk of breach of contract by the custodian, risk of breach of contract by the fund manager, fund custodian The risk of breach of contract violation. When the above-mentioned institutions fail to perform due diligence, or their internal operations, improper operation of the system or mistakes, they may cause losses to the holders of the special plan shares.

(3) Special risks of sub-special plan share holders

According to the agreement of the special plan document on the order of distribution of the special plan share income, the sub-special plan share is inferior to the priority special plan share to obtain the special plan benefit distribution, and provides internal credit for the priority special plan share. If there is a major loss in the assets of the special plan, the holder of the sub-special plan share may face a significant loss of the principal or even a zero risk.

1.3 Risks associated with a specific program

(1) Risk cost of rating decline

The special plan priority special plan share initial rating is AAA. The credit rating agency's rating of the special program share is not a recommendation to buy, sell or hold a special plan share, but only a judgment on the expected income of the special plan share and the possibility of repayment of the principal, and cannot guarantee the rating of the special plan share. Stay at this level all the time. The rating agency may revoke or lower the rating of the special plan share in the follow-up rating report according to the future situation, which will have a negative impact on the value of

the special plan share, including but not limited to: (1) special plan share price fluctuation; The proportion of the special plan after the downgrade exceeds the investment range of the investor.

(2) Risk of early termination of special plan

Due to the early termination of the special plan as stipulated in the “Plan Description” and “Standard Terms”, the special plan is terminated early, so that the special plan share holder may not be able to obtain the risk of part of the expected income of the special plan.

(3) Interest rate risk

Market interest rates will fluctuate as the macroeconomic environment changes, and interest rate fluctuations may affect the income of the special plan share holders. This risk is manifested as: the expected return on the priority special plan share is relatively fixed, and its market price may fall when the market interest rate rises.

(4) Liquidity risk

The special plan share of this special plan can be transferred and distributed on the platform of the SSE's integrated electronic platform for fixed income securities and its approved platform. In the case of a limited number of counterparties, the holder of a special plan share may face the risk of not being able to sell the share of the special plan at a reasonable price within a reasonable time.

1.4 Other risks

(1) Risk of changes in the legal and policy environment

The asset support special plan is still an innovative product in the securities market. There are still some perfect spaces for laws, policies and systems related to the operation of special plans. For the duration of this special plan, changes in relevant policies, laws and regulations may result in special plans. Have an adverse effect. At the same time, adjustments and changes in national or local policies such as monetary policy, fiscal policy, taxation policy, industrial policy, investment policy and related supporting regulations may affect the income level of investment under the special

plan.

(2) Tax risk

When the special plan is allocated, the tax collection and management laws and regulations applicable to the holders of the special plan shares may change due to the adjustment of the relevant tax policies of the state. For example, the tax department imposes any additional tax burden on the holders of the special plan shares. The relevant institutions are not responsible for any compensation, and the investor's income may be affected by the adjustment of relevant tax policies.

(3) Technical and operational risks

In the daily transactions of the special plan, the normal operation of the transaction may be affected by the failure or error of the technical system or the interests of the investor may be affected, and the special plan may be adversely affected due to operational errors or violation of the operating procedures.

(4) Other unpredictable risks

During the duration of the special plan, other unpredictable risks that the manager cannot prevent may adversely affect the assets and income of the special plan.

Based on the above-mentioned sources of risk, we selected the most important risk sources, the risk of fluctuations in the operating income of the underlying assets, as the main risk control target, and creatively used the panel data formed by financial indicators and non-financial indicators to monitor. Next we will detail the financial risk control indicators and non-financial risk control indicators.

2. Part two: Financial analysis index

In the establishment of financial analysis indicators, we mainly use two methods, namely Z-score financial early warning model and KMV default risk model. The two models are static monitoring and dynamic monitoring, which realizes comprehensive monitoring of enterprise risks. However, both models are derived from the United States and are not directly applicable to the analysis of Chinese enterprises. Next, we will introduce the correction process of the two models in detail. .

2.1 The introduction of Z-score model theory

The Z-score financial warning model was first proposed by Edward Altman, which has been revised by scholars since then. It can sensitively and accurately warn financial risks. The core function of the Z-score model is to warn financial risk. It combines the different indicators in the financial statements to accurately calculate the risk index of the company's finances and predict the degree of financial risk of the company within one to two years. The most significant advantage of this model is that it can integrate multiple financial indicators which measure the financial status of the company into a risk warning index. Then we can use the index to measure the financial status of the enterprise and to judge its ability to resist risks. The model can not only enable the enterprise managers to capture the signs of the financial crisis in advance, evaluate the degree of crisis, thereby adjusting the business plan and strategy, but also facilitate the financial institutions to quantify the financial risks of the enterprise.

The Z-score model has been recognized by the industry for its many advantages. And it has been widely used in the United States, Australia, Japan and other countries. At the same time, it meets our requirements for quantifying corporate financial risk through cross-sectional data, and the model is simple and easy to apply, so we use Z-score model to quantify financial risks and make financial warnings.

2.2 The design of modifying Z-score model

2.2.1 The necessity of modifying Z-score model

The Z-score model was first proposed by altman in the 1960s, which analysed US bankrupt companies and non-bankrupt companies. However, in China, due to the different economic systems, bankruptcy is not the same as the closure of business. Therefore, using the Z-score model to judge whether a company has a financial crisis is more suitable for China's national conditions. In addition, many scholars in China have done a lot of researches on the applicability of Z-score model in China. They found that Z-score model has significant differences in different industries, and the

financial indicators which were used to quantify risks should also be revised. This module aims to quantify the financial risks of real estate companies in China, so it is essential to correct the Z-score model.

2.2.2 Select sample

In order to obtain correction model parameters of the Z-score model more accurately, we selected 111 real estate listed companies as samples. The 24 real estate enterprises with total asset turnover ratio below 0.2331 for the second consecutive year in 2013-2017 were divided into financial crisis groups, and the relevant year was recorded. We took the data of the two years before the financial crisis as sample data, that is, the financial distress occurred in the Nth year, and the financial data of the (N-2) year was taken as the analytical data. As shown in Table 2-1.

Table 2-1

Securities code	Securities name	Securities code	Securities name
600754.SH	Jinjiang	000797.SZ	Wuyi, China
900934.SH	Jinjiang B shares	002208.SZ	Hefei City
601155.SH	New Town Holdings	000042.SZ	Zhongzhou Holdings
000002.SZ	Vanke A	600565.SH	Dima shares
000615.SZ	Jinghan shares	000011.SZ	Deep Property A
002244.SZ	Binjiang Group	200011.SZ	Deep Property B
000718.SZ	Suning Global	600048.SH	Poly Real Estate

At the same time, 24 real estate enterprises with a total capital turnover ratio of more than 0.2331 for five consecutive years were selected as the sample of the financial health group, and the average value of each financial indicator for five years was used as the analysis data of the indicator. As shown in Table 2-2.

Table 2-2

Securities code	Securities name	Securities code	Securities name
600733.SH	SST forward	600393.SH	Yuetai Shares
000809.SZ	Tieling New Town	000965.SZ	Tianbao Infrastructure
000534.SZ	Wanze shares	000517.SZ	Rongan Real Estate
600622.SH	Everbright Garbo	000861.SZ	Haiyin shares
600246.SH	Wantong Real Estate	600730.SH	China High Tech
000428.SZ	Huatian Hotel	600748.SH	Real development
000897.SZ	Jinbin Development	600823.SH	Shimao shares

2.2.3 Selection of financial indicators

In order to follow the principles of operability and priority, we selected 20 basic financial indicators to reflect the solvency, cash flow, profitability, operational capability, development capability, and enterprise size of the company. Through the most efficient Man-Whitney U (M-W-W) non-parametric statistical test method, the financial indicators with insignificant differences between the two groups were eliminated, and the financial indicators with significant differences were retained. Therefore, this method can play the role of dimensionality reduction and simplification under the premise of reflecting the main information of the original variables. Two independent sample groups: the financial crisis sample group and the financial health sample group were assigned values of 0 and 1. The test results are shown in Table 2-3, Table 2-4, and Table 2-5.

Table 2-3

Test Statisticsa

	Current ratio	Quick ratio	Cash ratio	Working capital / total assets	Assets and liabilities	Property ratio	Cash flow ratio
Mann-Whitney U	216.000	287.000	235.000	226.000	273.000	251.000	176.000
Wilcoxon W	516.000	587.000	535.000	526.000	573.000	551.000	476.000
Z	-1.485	-0.021	-1.093	-1.279	-0.309	-0.763	-2.310
Asymp. Sig.	0.138	0.984	0.274	0.201	0.757	0.445	0.021

a. Grouping Variable: Assignment

Table 2-4

Test Statisticsa

	Debt guarantee rate	Operating income cash ratio	Sales margin	Return on total assets ROA	Total net asset interest rate	Return on equity	Accounts receivable turnover
Mann-WhitneyU	159.000	189.000	265.000	245.000	238.000	166.000	202.000
Wilcoxon W	459.000	489.000	565.000	545.000	538.000	466.000	455.000
Z	-2.660	-2.042	-0.474	-0.887	-1.031	-2.516	-1.364
Asymp. Sig.	0.008	0.041	0.635	0.375	0.303	0.012	0.173

a. Grouping Variable: Assignment

Table 2-5

Test Statisticsa

	Inventory turnover	Current asset turnover	Total asset turnover	YoY growth of total assets	Year-on-year growth in operating income	Retained earnings/assets total
Mann-WhitneyU	215.000	237.000	160.000	172.000	282.000	231.000
Wilcoxon W	515.000	537.000	460.000	472.000	582.000	531.000
Z	-1.505	-1.052	-2.640	-2.392	-0.124	-1.175
Asymp. Sig.	0.132	0.293	0.008	0.017	0.902	0.240

a. Grouping Variable: Assignment

Through the MWW test at 5% significant level, we found that the cash flow ratio, debt guarantee rate, operating income cash ratio, ROE, total asset turnover, and year-on-year growth in total assets had significant difference between the two sample groups (P<0.05). Therefore, we selected these 6 variables for the next test.

2.2.4 The establishment of a modified Z-score model

Taking the company group (Financial Health Group and Financial Crisis Group) as independent variables, the six financial indicators of the M-W-W test were used as the dependent variables, and Wilk's Lambda's λ statistic minimization method was selected for discrimination. According to the numerical relationship between the value of F and λ, we can use the value of λ to eliminate the financial indicator variable whose F value was less than 2.71. Finally, the model was constructed based on the Fisher criterion which has no requirement on overall distribution. The results are shown in Table 2-6.

Table2-6

Canonical Discriminant Function Coefficients

	Function
	1
Debt guarantee rate	4.721
Total asset turnover	9.078
YoY growth of total assets	0.039
(Constant)	-3.812

Unstandardized coefficients

Table 2-6 shows the unstandardized coefficients of each variable. The variables can be

directly substituted into the function to calculate the score of Z. Compared with standardized functions, it is simpler to apply.

A modified model of the Z-value model with China's real estate industry's characteristics can be expressed as:

$$\mathrm{Z} = -3.812 + 4.721X_1 + 9.078X_2 + 0.039X_3$$

Of which: X1 = debt guarantee rate

X2 = total asset turnover

X3 = year-on-year growth in total assets

2.2.5 Determination of Z-score modified model interval

We calculated the group center of gravity of the two samples respectively by using the modified model obtained in the previous step. When using the revised model for discriminating, the enterprises which close to the center of the financial crisis group are classified into the financial crisis group, indicating that the parameter index of the enterprise are in a bad state. And the enterprise may fall into financial crisis in the next two years. Similarly, the enterprise which close to the center of the financial health group are divided into the financial health group, indicating that the financial status of the company is working well. The company between the two groups' centers is in a gray area, indicating that the company may have a financial crisis in the future. After calculating, the gravity of the financial crisis group is -0.74173, and the gravity of the financial health group is 0.747048.

$$\mathrm{Z-score\ model\ discriminant\ interval}\begin{cases} Z > 0.747048 & Financial\ health \\ -0.74173 < Z < 0.747048 & Gray\ zone \\ Z < -0.74173 & Financial\ crisis \end{cases}$$

2.2.6 Test of Z-score modified model

In order to test the Z-score modified model, we used the original sample back-test method. First, the judgment threshold was determined by the middle position of the gravity centers of the two groups. Then we calculated the corrected value of the 48 sample companies and compared with the threshold. After calculating, the threshold value was 0.002661. Finally, 43 enterprises were predicted successfully and 5

companies were not predicted successfully. The corrected Z-score model has a prediction accuracy of 89.6%. In conclusion, this revised model has a strong interpretation and forecasting ability for China's real estate company financial risk, and has good applicability in China's real estate industry.

2.3 Brief introduction to the KMV model

The KMV model was established by the KMV Company of San Francisco in 1997 to estimate the probability of default. The KMV model considers that the credit risk of corporate loans is determined by the debtor's asset market value in the case of given liabilities. An enterprise may default if its market value is greater than its liabilities. Based on the formula of Black-Scholes (1973) and Merton (1974) option pricing, the equity value owned by shareholders is regarded as a call option. By measuring the stock price of the enterprise, the value of the enterprise's assets and the fluctuation of asset income are speculated, and the probability of the enterprise's default is estimated.

KMV model has become one of the most popular risk management models in international finance because of its many advantages. First, KMV can make full use of the information on the capital market to quantify and analyze all publicly listed companies' credit risk. Secondly, as the data obtained from the model come from the stock market data, it can reflect the current credit status of the enterprise, which is forward-looking, and its forecasting ability is stronger and timelier. It is also more accurate. In addition, KMV model is based on contemporary corporate finance theory and option theory, and has a strong theoretical basis. Therefore, we use the KMV model to predict the default risk of individual enterprises.

2.4 The basic principle of KMV model

The KMV model assumes that the value of the enterprise assets is taken from a certain distribution in the coming period (general assumption obeys the Normal Distribution), which can be determined by the expected value of the enterprise assets and the volatility of the asset value.

The basic principles are as follows:

(1) Estimate the value and volatility of the enterprise's assets. In the assumptions of the option pricing model, the asset value V_t obeys the geometric Brown motion

$$dV_t = \mu V_t dt + \sigma_V V_t dz \quad ①$$

Among them, V_t and dV_t are the value of enterprise assets and its rate of change, μandσ_V are the expected growth rate of enterprise assets and the volatility of asset value, and dz is the Wiener process. According to the option pricing formula of Black and Scholes, when t=0, equity value can be expressed as

$$E_0 = V_0 N(d_1) - De^{-rT} N(d_2) \quad ②$$

Among them,

$$d_1 = \frac{\ln(V_0/D) + \left(r + \frac{1}{2}\sigma_V^2\right)T}{\sigma_V\sqrt{T}} \quad ③$$

$$d_2 = d_1 - \sigma_V\sqrt{T} \quad ④$$

Among them, D is the book value of liabilities, R is risk-free interest rate, and T is the maturity date of liabilities.

Since equity value E_t can be expressed as a function of asset value V_t and time t, because of the Ito lemma, the equity value also obeys geometric Brown movement, so when t=0,

$$\sigma_E E_0 = N(d_1)\sigma_V V_0 \quad ⑤$$

Simultaneous equation 2 can be obtained when t=0 assets value V_0 and asset value volatility σ_V. And then when the T is available the value of the enterprise assets V_t :

$$V_t = V_0 \exp\left[\left(\mu - \frac{1}{2}\sigma_V^2\right)t + \sigma_V\sqrt{t}\varepsilon\right] \quad ⑥$$

Among them, the variableε obeys the Standard Normal Distribution.

(2) Computing default distance DD. The US enterprise default point (DP) given by KMV is:

$$\mathrm{DP} = \mathrm{ShortDebt} + 0.5\mathrm{LongDebt} \quad ⑦$$

Default distance DD is:

$$\mathrm{DD} = \frac{\ln(V_0/D) + \left(\mu - \frac{1}{2}\sigma_V^2\right)T}{\sigma_V\sqrt{T}} \quad ⑧$$

Or

$$\mathrm{DD} = \frac{E(V_T) - DP}{E(V_T)\sigma_V} \qquad ⑨$$

(3) Calculated expected default probability (EDF). According to the Merton model, assuming that the value of enterprise assets obeys normal distribution, EDF is

$$\mathrm{EDF} = \Pr(\mathrm{E}(V_t) < DP)$$

$$= \mathrm{N}\left(-\frac{\ln(V_0/D) + \left(\mu - \frac{1}{2}\sigma_V^2\right)T}{\sigma_V\sqrt{T}}\right) = N(-DD) \quad ⑩$$

2.5 Modification of KMV model

2.5.1 The necessity of modifying the KMV model

Since the default point of KMV's model is based on the experience obtained from the US history database, it is not necessarily in line with the actual situation of the enterprises in our country, so it is necessary to modify the setting of the breach.

2.5.2 Select samples

In order to meet the characteristics of the real estate industry DP expression correction parameters more accurately, we selected the first half of the first half of 2007-2018 ST A shares listed real estate enterprises as samples, a total of 27, excluding the 3 without relevant financial information, sample capacity of 24, the analysis of data selected by the enterprise was the previous year of the financial data of the ST.

As shown in Table2-7.

Table 2-7

Code	name	Implementation date	Code	name
600807.SH	*ST Tianye	2018-05-03	000036.SZ	Hualian
600696.SH	ST rock	2017-03-29	000011.SZ	Deep Property A
600733.SH	SST forward	2017-03-22	600817.SH	ST Hongsheng
600225.SH	Tianjin Songjiang	2017-03-21	600604.SH	Beibei High-tech
000691.SZ	Asia Pacific Industry	2016-05-04	600466.SH	Blu-ray development
600675.SH	Chinese company	2016-03-22	600094.SH	Daming City
600732.SH	ST Xinmei	2015-04-29	600716.SH	Phoenix shares
600555.SH	HNA Innovation	2013-05-03	000981.SZ	Yinyi Shares
000056.SZ	Royal Court	2012-04-23	600052.SH	Zhejiang Guangsha

	International			
000838.SZ	Financial development	2012-04-05	000007.SZ	Brand new
600733.SH	SST forward	2012-03-16	000965.SZ	Tianbao Infrastructure
600185.SH	Gree Real Estate	2009-05-04	600223.SH	Lushang Real Estate

2.5.3 Modified DP expression

In the KMV model, the default point is a linear combination of current liabilities and long-term liabilities, and DP is amended accordingly. With the current liabilities and long-term liabilities of the year before ST as independent variables and the total assets as dependent variables, the multiple linear regressions with no intercept term was carried out. The results are shown in Table 2-8 and Table 2-9.

Table 2-8

Coefficienta,b

Model		Non standardized coefficient		Standard coefficient	t	Saliency
		B	Standard error	Beta coefficient		
1	Total Non-current Liabilities	1.108	.137	.364	8.091	.000
	Total Current Liabilities	1.126	.077	.654	14.538	.000

a. Dependent variable: total assets

b. Linear regression through the origin

Table 2-9

Model summary

Model	R	R squareb	Adjusted R square	Error of standard estimation
1	.996a	.992	.992	792147604.3251874

a. Forecast variable: current liabilities Total, non-current liabilities Total.

b. For regression that passes through the origin (no intercept model), the R-square measures the variable proportion in the dependent variable about the origin of the regression interpretation. This can not be compared with the R side of the intercepting model.

Regression results showed that all coefficients were highly significant and the model fitted well. As a result of correction

$$\mathrm{DP} = 1.108\mathrm{ShortDebt} + 1.126\mathrm{LongDebt}$$

2.5.4 GARCH(1,1) model

For estimating stock price volatility，there are two kinds of static models and dynamic models. The static model is generally the historical volatility method. Assuming the variance of the stock price is stable, the result is obtained by calculating the arithmetic average of the historical data. However, in fact, the volatility of the stock price does not conform to the hypothesis of static model, and there is a phenomenon of heteroscedasticity and aggregation. Therefore, we use dynamic model to estimate the volatility of stock prices. There are there commonly used dynamic models: the moving average model(MA),the exponential moving average(EWMA) and the generalized autoregressive conditional heteroscedasticity model(GARCH).We use the GARCH(1,1) model which is especially suitable for the estimation of the financial time series. The GARCH model:

$$y_t = c + xy_{t-1} + \varepsilon_t \qquad ①$$
$$\sigma_t^2 = \omega + \alpha\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 \qquad ②$$

α is the return confficient, β is the lag term coefficient, ① is the conditional mean equation, ② is the conditional variance equation to explain the variation characteristics of conditional variance.

2.5.5 KMV model estimates EDF

1. Estimation of volatility of equity value

The value of equity is mainly determined by fluctuation of stock price, and the widely used GARCH (1, 1)model is used to estimate the volatility First, we calculate the daily logarithmic yield of equity value and then use the GARCH(1,1) model to estimate the volatility of the daily return rate of equity value, and finally get the annual volatility of equity value σ_E according to the daily fluctuation.

2. The choice of risk free interest rate.

Due to the lack of a mature capital mechanism in China, it’s difficult to estimate the risk free interest rate. With the gradual advance of the reform of China’s interest rate market, the estimation of the risk free interest rate will be more accurate. In view of

the financial market is gradually forming a pricing system based on Shibor, so the interbank offered rate in Shanghai is used as risk-free interest rate. As of August, 3, 2018, the latest one-year Shibor interest rate was 3.51%.

3. EDF calculation results

We selected a share listed real estate companies to calculate their EDF through the KM model. The results are shown in table 2-10.

Table 2-10

name	DD	EDF
AVIC Shanda	2.3229	0.0101
Changchun Economic Development	2.4814	0.0065
Shin Kong Round	2.3997	0.0082
Development	2.6813	0.0037
Wanye Enterprise	2.9335	0.0017
Wanze shares	3.0535	0.0011
COFCO Real Estate	2.2333	0.0128
Hefei City Construction	2.8039	0.0025
New Town Holdings	1.98	0.0239
Blu-ray development	2.5751	0.005

3. Part three: Non-financial analysis indicators

3.1 introduction of non-financial risk analysis theory

Traditional risk analysis only focuses on the limited indicators contained in financial statements, which is a static analysis without continuity. Based on the analysis of traditional financial indicators, our team innovatively used the analysis method of big data environment. The method has a strong ability to predict large data and has the feather of continuity, the dynamic characteristics of this group with the crawler technology real-time grasping enterprise surrounding traffic, real-time rental prices, such as parking lot parking rate index, forming a set of evaluation index for the correct time sequence, the future of enterprise operating performance, operating cycle, the surrounding environment condition for real-time feedback and forecast.

Big data analysis was widely accepted by the industry because of its many advantages,

however, due to the difficulty to get the data, difficulty in real-time monitoring and other issues it have not been widely adopted. The team used the crawler method to overcome the data acquisition and real-time monitoring and difficult problems, combined the traditional financial analysis with big data environment analysis of the organic and create a new set of risk control model.

3.2 construction of environmental risk index

3.2.1 Index selection

First, we classified the target financing enterprises into residential ones and non-residential ones. We chose rent, evaluation, facilities and other indicators to analyze residential long - rent apartment enterprises. For non-residential enterprises, human flow, parking rate, evaluation and other indicators are selected for analysis. These indicators are very helpful for us to analyze the enterprise and make a good prediction of the enterprise's operation status.

3.2.2 Data processing

In order to make the data more objective and intuitive to reflect the business situation of enterprises, we chose the normalization method and the analytic hierarchy process, quantified the data and drew up an environmental risk index. With the support of crawler technology, the goal of dynamic, continuous and time series data based risk quantification is realized.

1. AHP weighting process

AHP method refers to the decision method that decomposes the elements which always related to the decision into goals, criteria, plans and other levels, and conducts qualitative and quantitative analysis on this basis. We divide the weighting into the following three steps.

（1） construct the judgment matrix

Table 3-1

A	A1	A2	A3	
A1	1.000	7.000	5.000	
A2	0.143	1.000	0.500	
A3	0.200	2.000	1.000	
	1.343	10.000	6.500	17.843

Where A1 is the rent, A2 is facilities and A3 is the evaluation, and by comparing them with each other and adopting the relative scale method, A1 solves the problem that various factors of different nature cannot be compared and improves the accuracy.

(2) calculate the eigenvector and index weight of the matrix

First, the A value of each column is added up, and then each column is normalized. The formula is as follows:

$$B_{ij} = \frac{A_{ij}}{\sum A_{ij}}$$

1） get a new B matrix

Table 3-2

B	B1	B2	B3
B1	0.745	0.700	0.769
B2	0.106	0.100	0.077
B3	0.149	0.200	

2） sum each row to get the eigenvector

Table 3-3

B	B1	B2	B3	Sum
B1	0.745	0.700	0.769	2.214
B2	0.106	0.100	0.077	0.283
B3	0.149	0.200	0.154	0.503
Sum	1.000	1.000	1.000	

3） calculate the weight of the index and normalize the feature vector. The formula is as follows:

$$Wi = \frac{B_j}{\sum B_j}$$

Table 3-4

B	B1	B2	B3	Sum	W	W%
B1	0.745	0.700	0.769	2.214	0.738	0.738
B2	0.106	0.100	0.077	0.283	0.094	0.094
B3	0.149	0.200	0.154	0.503	0.168	0.168
Sum	1.000	1.000	1.000	3.000	1.000	1.000

At this point, we can get the weight of the three indicators, which are 73.80%, 9.44% and 16.76% . Finally, we need to test the weight, namely, the consistency of the matrix.

(3) consistency test of matrix

1) calculate the maximum characteristic root of the matrix, and the formula is as follows:

$$\alpha_{max} = \frac{\sum(AW)_i}{nW_i}$$

Table 3-5

W%	AW	AW/W
0.738	2.234	3.027
0.094	0.300	3.177
0.168	0.462	2.754
1.000	2.996	8.958
	Characteristic root	2.986

2) calculate the consistency index of the judgment matrix, and the formula is as follows:

$$C.I. = \frac{\alpha_{max} - n}{n - 1}$$

n: represents the order of the matrix

3) calculate the random consistency ratio

Test the consistency index of a matrix and as the random consistency ratio of the matrix, and the calculation formula is:

$$C.R. = \frac{C.I.}{R.I.}$$

Table 3-6

R.I.	0.520	
Characteristic root	2.985987	
C.I.	-0.00701	
Consistency ratio	-0.01347	Less than 0.1 so consistency is maintained

After testing, the consistency ratio =-0.01347<0.1, indicating that the comparison matrix maintained a significant level.

2. normalization method

Normalization is a way to simplify the calculation. The expression with dimensions will be transformed into the expression without dimensions and become pure quantity. We use the normalization method of linear functions to transform the original three indicators with different units into a unified range [0,1]. This method achieves the scaling of the original data with equal proportions. The normalization formula is as follows:

$$X_{norm} = \frac{X - X_{min}}{X_{max} - X_{min}}$$

3. non-residential weight

Similarly, we obtained the weight of the three indicators of non-residential enterprises: human traffic (66%), parking rate (28%) and evaluation (6%).

Table 3-7

Sum	1.444	4.167	16	21.611	
	B1	B2	B3	Sum	Weights
B1	0.692	0.720	0.563	1.975	0.659
B2	0.231	0.240	0.375	0.846	0.282
B3	0.077	0.040	0.063	0.179	0.060
Sum	1	1	1	3	1
			Eigenvalues	2.948	C.I.
	R.I.	0.520	consistency	-0.050	

In conclusion, combined with normalization method and analytic hierarchy process, we has developed an environmental risk index, which can realize the goal of real-time monitoring and forecasting of enterprise operation.

Part four: Model operation process

The model running process is shown in figure 4-1. The model running process is mainly composed of three parts:

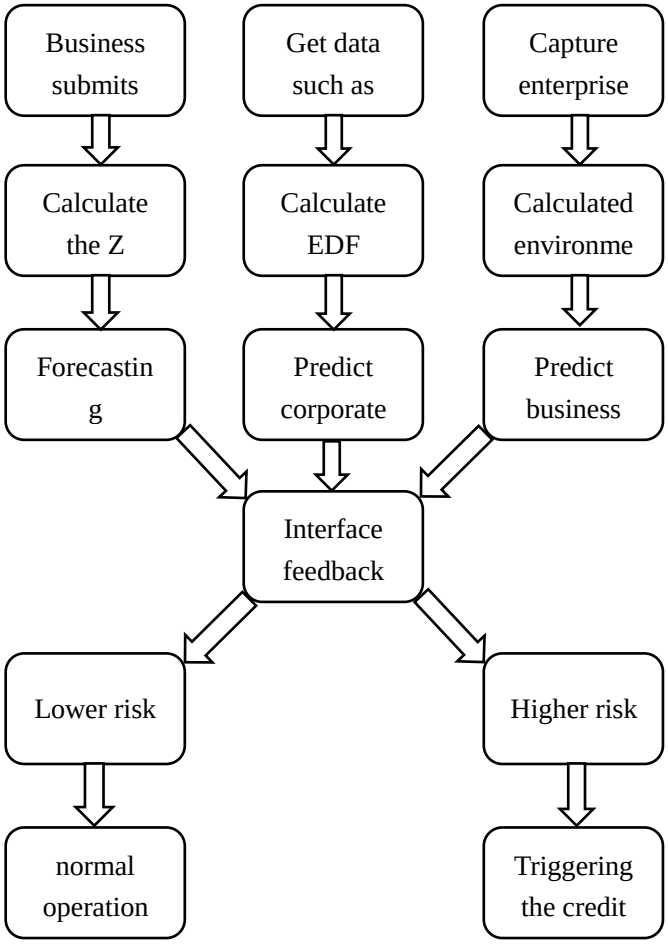

Figure 4-1

（1）the indicators measure corporate financial risk according to financial statements.

First of all, the target enterprise needs to submit the financial statement at a certain time for our review. Then, after receiving the financial statement, we use the modified z-value model for detection, compare the output z-value with the threshold value, and judge whether the enterprise was in the health group, the unhealthy group or the gray zone.

（2） Predict the future operating risks of enterprises according to non-financial indicators

A dynamic monitoring module is embedded in the platform, which crawls the required

data on major network platforms, imports the acquired data into the risk calculation function, and outputs the risk index. The output data will form a historical database in the form of time series. The platform will monitor and predict the fluctuation of the enterprise's current and future operating risks by monitoring the change trend of the generated risk index and comparing it with the warning line. Investors can also understand the operation status of enterprises in the historical database, so as to make rational judgment.

（3） Comprehensive financial risk indicators and non-financial risk indicators

Trough the two aspects of the comprehensive interface feeback，the financial risk index is the main factor，the non-financal risk standard is supplemented，the lower risk can continue to run，and the enterprise with higher risk will trigger the augmented mechanism to protect the investor’s rights and interests.

Part five: Discarding example analysis

As of the end of 2016, Vanke Port has entered a total of 18 cities and has opened 44 projects, mainly in first- and second-tier cities. The occupancy rate of properties that have been in operation for more than three months has reached 90%. Vanke Port has mastered a large number of high-quality properties with Vanke's self-sustaining properties and standard decoration. Whether it is domestic or foreign, Vanke Port has a strong typicality in the industry, and it is the benchmark for other companies in the same industry to follow. Therefore, this project uses Vanke's apartment as a case for analysis.

5.1 calculation of financial indicators

1. Z value model

X1: debt security rate calculation formula: net cash flow of operating activities/current liabilities

X2: total assets turnover rate calculation formula: industry income/average total assets

X3: the year-on-year growth rate of total assets calculation formula: total assets at the

end of the period - total assets at the beginning of the period/total assets at the beginning of the period

According to Z value model Z=-3.812+4.721X_1+9.078X_2+0.039X_3 and financial statements (simulation)

Table 5-1

financial indicator	2018-03-31	2017-12-31	2017-09-30	2017-06-30	2017-03-31
Basic earnings per share (yuan)	0.150	2.710	0.900	0.510	0.020
Net assets per share (yuan)	9.380	9.130	7.150	6.780	6.600
Cash flow per share (yuan)	-1.330	-4.640	-1.730	-3.300	-2.320
ROE（%）	1.720	34.180	12.810	7.440	0.280
Net profit year-on-year (%)	752.610	99.680	125.590	33.660	
Same rate of revenue (%)	154.210	44.890	42.330	24.870	77.950
Gross profit margin (%)	36.410	35.560	37.380	36.230	38.870
Income statement (yuan)					
Total revenue (100 million)	51.790	405.260	168.560	113.280	20.370
Total profit (100 million)	4.840	83.710	28.170	16.450	7942.680
Net profit (100 million)	3.600	60.290	19．920	11.390	4227.150
Balance sheet (yuan)					
Total assets (100 million)	1947.870	1835.270	1488.190	1398.420	1157.720
Total liabilities (100 million)	1680.220	1575.450	1316.800	1229.450	992.060
Total shareholders' equity (100 million)	267.650	259.820	171.390	168.970	165.650
Cash flow statement (yuan)					
Operating cash flow	-29.990	-104.850	-39.090	-74.610	-52.450
Investment cash flow	-78.140	2.440	-70.220	-15.390	-24.570
Financing cash flow	61.380	189.700	145.350	137.040	64.720
Net cash flow	-46.750	87.290	36.050	47.030	-12.310

The calculation results are as follows:

Table 5-2

Debt guarantee rate	Asset turnover	Year-on-year grow in assets	Z value
-0.080	0.283	77.887	1.412

Z value (1.41236) > critical value (0.747048), Vanke Port is in a state of financial health.

2. KMV model

Get its 2017 daily closing price and calculate its logarithmic rate of return. Perform an ADF test:

Table 5-3

Null Hypothesis: SHOUYI has a unit root			
Exogenous: Constant, Linear Trend			
Lag Length: 0 (Automatic - based on SIC, maxlag=14)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-15.76506	0.0000
Test critical values:	1% level	-3.996431	
	5% level	-3.428503	
	10% level	-3.137665	
*MacKinnon (1996) one-sided p-values.			

The ADF value is less than the critical value, and the stock price return time series does not have a unit root and is a stationary sequence. Estimate stock price volatility using the GARCH(1,1) model:

Table 5-4

Dependent Variable: SHOUYI				
Method: ML - ARCH (Marquardt) - Normal distribution				
Included observations: 243 after adjustments				
Convergence achieved after 8 iterations				
Presample variance: backcast (parameter = 0.7)				
GARCH = C(1) + C(2)*RESID(-1)^2 + C(3)*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
	Variance Equation			
C	7.70E-05	2.39E-05	3.217287	0.0013
RESID(-1)^2	0.111695	0.035607	3.136905	0.0017
GARCH(-1)	0.753354	0.066168	11.38552	0.0000

another: GARCH = 7.70143378705e-05 + 0.111694859777*RESID(-1)^2 + 0.753354191924*GARCH(-1)

The estimated daily volatility is 0.026986, and the annual volatility is 0.426690555. The calculation results are as follows. The average market value of 2017 is 40450299058.8125, the current liability is SD=130476342875, and the long-term debt LD=27068544190, taking T=1, r=0.03551. Substituting into the matlab program is DD=1.98, EDF=0.0239.

5.2 calculation of environmental risk index

First of all, we collected the information about the environment of in Guangzhou. Part of the situation is shown in Table 5-5 (short form).

Table 5-5

Listing number	Listing name	Address (total)	floor	area	Room type	price	Advantage
/gz/fang/gongyu46-248680.html	[Whole Rent] Wenchong Vanke Yuncheng Mi Cool 1 Room 0 Hall	Huaguan Road Vanke Yuncheng Mi Cool	5/17 floor	18 ㎡	1 room 0 hall 1 bathroom	1499	Diverse living facilities
/gz/fang/gongyu46-248636.html	[Whole Rent] Longdong Vanke Yuncheng Mi Cool 1 Room 0 Hall	Huaguan Road Vanke Yuncheng Mi Cool	5/17 floor	25 ㎡	1 room 0 hall 1 bathroom	1850	Separate balcony, separate bathroom, kitchen
/gz/fang/gongyu46-245748.html	[Full rent] 2 rooms, 1 room, Vanke Peak, Binjiang	It is 689 meters from the Cultural Park Metro Station of Line 6.	25/53 floor	124 ㎡	2 rooms, 1 living room, 1 bathroom	11000	Close to the subway, kitchen, separate balcony, separate toilet

The data were processed by the normalization method，and the rental price，the supporting facilities and the traffic situation were quantified.Then the renting price(73.80%),the supporting facilities(9.44),and the traffic(16.76%)were weighted to

get the final results.the environmental risk index of the Guangzhou Vanke in August 3，2018 was 0.384651369. Taking this as an example, the platform will continue to monitor the environmental risk index dynamically in real time.

6. Part six: the summary

According to the result of empirical test, it is easy to find that the revised Z-value model can measure the future financial risk of enterprises well and the environmental analysis index can also effectively predict enterprises' future business risk. Comprehensive financial indicators and non-financial indicators, on the one hand, can accurately help managers understand the internal financial situation of enterprises. On the other hand, they can assist managers in grasping the changes of the external operating environment of enterprises. In addition, the two kinds of indicators work together to achieve the transformation from traditional cross-sectional data monitoring to three-dimensional panel data monitoring in terms of enterprises' risk control. Although the whole model is still imperfect in modeling and testing, it has made bold innovation on the basis of existing theories and realized more effectively the supervision and prediction of enterprise risks, which has certain reference significance.