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The risk index research of multinational mining companies investment in China

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ABSTRACT

The process of mining project investment is a relatively lengthy process, the existence in this investment among the different stages of risks are different, and therefore making a comprehensive analysis of its risk factors. Process the underlying risk factors with effective collection and processing in the entire mining projects investment, making cross-border investment process can get adequate protection factors. Which risk factors were processed by scientific evaluation, corresponding evaluation model constructed by fuzzy mathematical method allows multinational mining companies to achieve a clear risk index of investment for maximizing return on investment and lay a solid foundation of theory and data.

KEYWORDS

Chinese mining; Cross-border investment; Risk index; Application of theory.

INTRODUCTION

From the developmental point of mining companies' investment, minimizing the risk index means that companies will be able to benefit from the effect evidently. In order to achieve this goal, the fundamental means is sucking the investment risk index for scientific computing, through scientific evaluation process of risk factors can make the risk index of investment and mining projects in a close contact, and then providing the effective protection factors for the multinational development of China's mining.

This research uses three aspects to process the discussion, such as the analysis of investment risk, the way of identification and handling of investment risk factors, the assessment study of mining investment risk, at the same time, the related capital asset pricing model is also used in this research, in order to provide strong support for achieving the continuous improvement of scientifical and rational calculation of Chinese mining enterprises transnational investment risk index. Thus making the process of this study and exploration of research ideas become more clearly and the process's target of this research can be effectively reflected.

THE ANALYSIS OF INVESTMENT RISK

Make an assessment of mining project risk, which includes the analysis of qualitative and quantitative evaluation. The analysis of investment risk is applied to the mining industry, due to the complexity of analytical methods and the difficult of obtaining basic data, making the analysis of mining investment risk be very difficult[1]. With the development of computer technology, risk analysis in Mining Engineering are gradually growing, The considering of the common methods of risks are introduced in the following research process in detail.

THE IDENTIFICATION AND TREATMENT OF INVESTMENT RISK FACTORS

Impact of investment results indicators for the identification of risk

According to the impact of mining investment projects to process the identification of risk, the specific process should be carefully planned, this process can be targeted in list of its indicators, and the process of specific identification is shown in Figure 1[2].

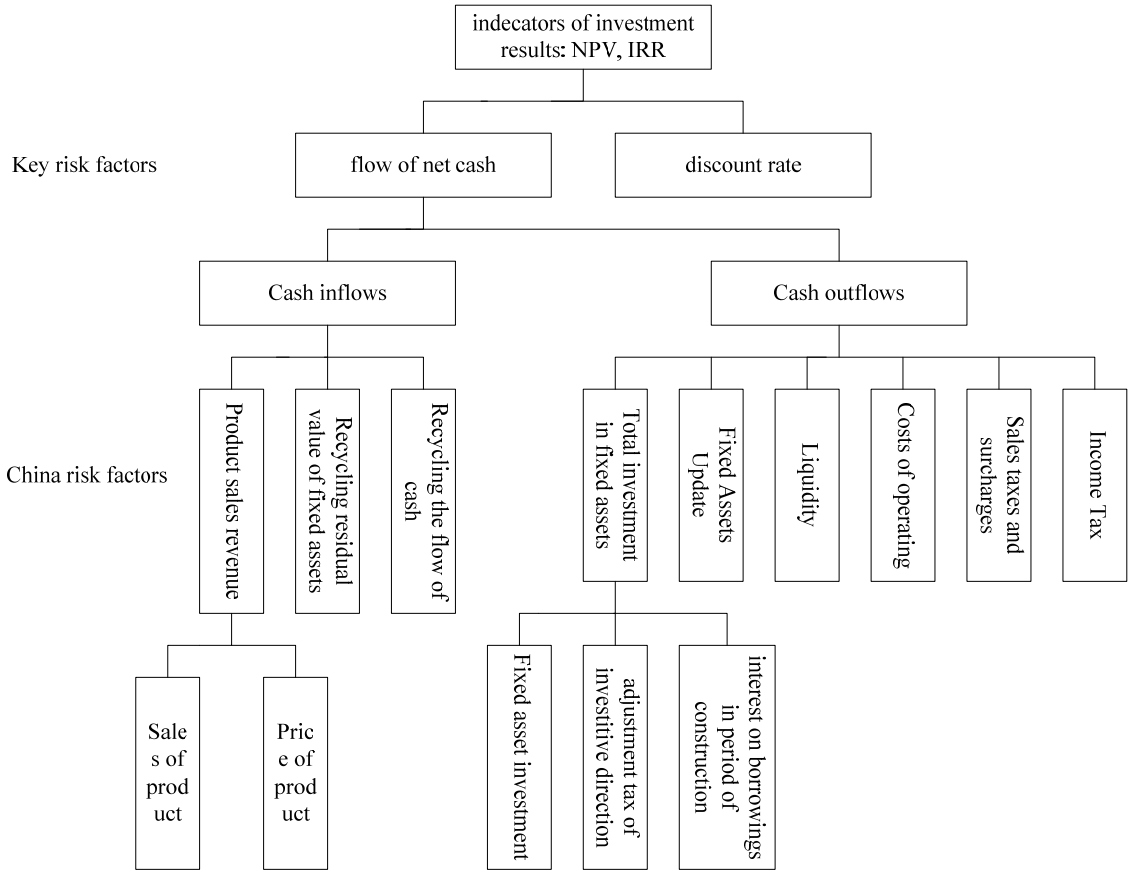

Figure 1 : Identify the risk factors by the influencing relationship

Identify risk factors in the stage of investment projects

The phased division of project risks

The risk factors for mining projects during the collection and processing, the first potential risks within the project should be divided into stages, in order to carry out well, which is based on the principle of the division of time period. There are mainly three stages in this division,such as the development, the production of investment and the production of achievement.

The principles of identification of investment projects' risk factors

Firstly, it should emphasize the importance of division on its risk factors,as for China's mining companies in cross-border investment process, because different stages of their investment risk existence are not the same. Secondly, it is likely to effectively identify the existence or be able to cause unnecessary losses from future risk factors. The third round should be carried out analysis of its risk factors, so that it can appear in the form of a minimum unit. The last feature is effectively identifying the industrial characteristics which are inherented in risk factors, and then making reference from their related information, their risk factors can also be effectively screened.

The acquisition and processing of risk factors

Random variables and their probability distribution

The detailed analysis and calculation process of China's mining enterprises conducting cross-border investment risk factors, while dealing with random variables should not only correspond to simulation process in different situations projections, but also including random parameters of this indicator. Concrete is generally derived from the probability distribution of the already sampled in total, making the nature of the distribution have the commonality[3]. Figure 2 below for which clearly demonstrate the process, and the relationship is described further.

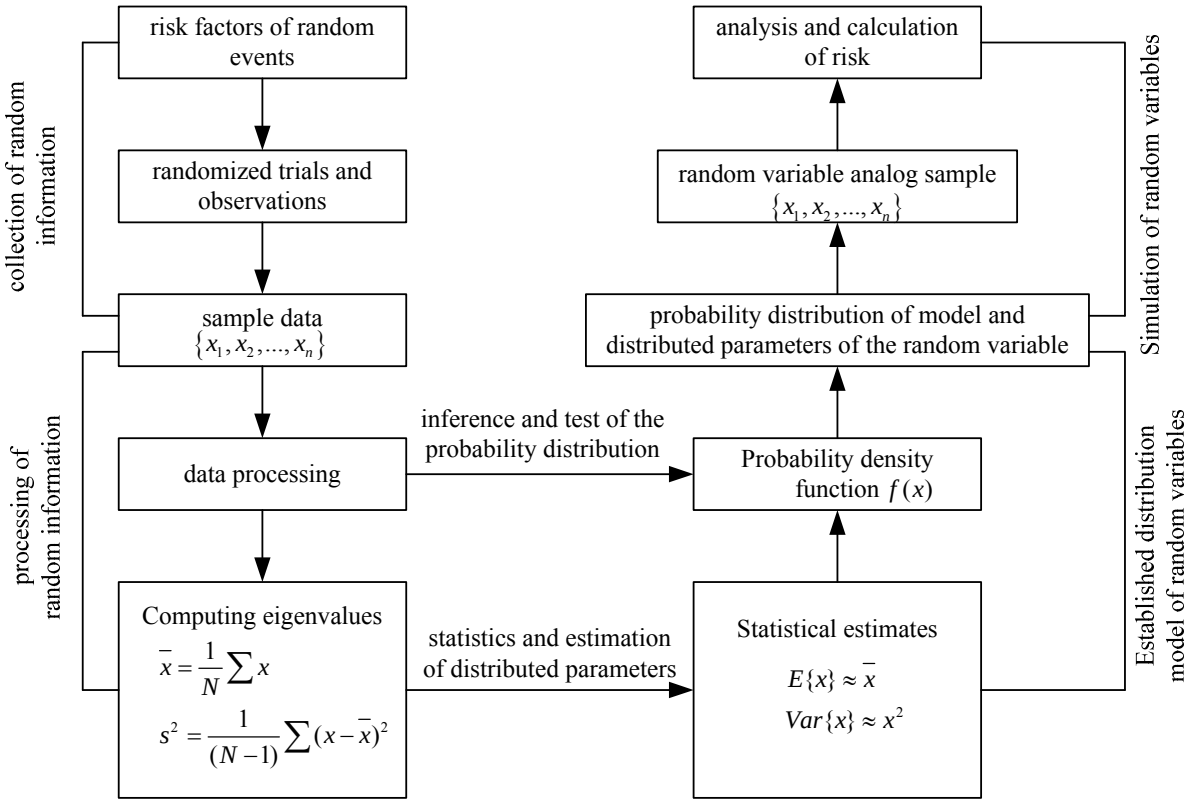

Figure 2 : Risk factors randomly collected information processing, analog, the figure of application process

The acquisition and processing methods of risk factors' random information

Conduct cross-border investments of venture enterprise risk index of the research process, we need effectively collect the random information which is generated by its risk factors and provide a strong guarantee for the proper conduct of the evaluation process, making the data evaluation process with a more strong "science" and "rationality". As for the type's

distribution of data, we should conduct effective research in this process, and able to carry out a scientific random sample inference, specifically as shown in Figure 3.

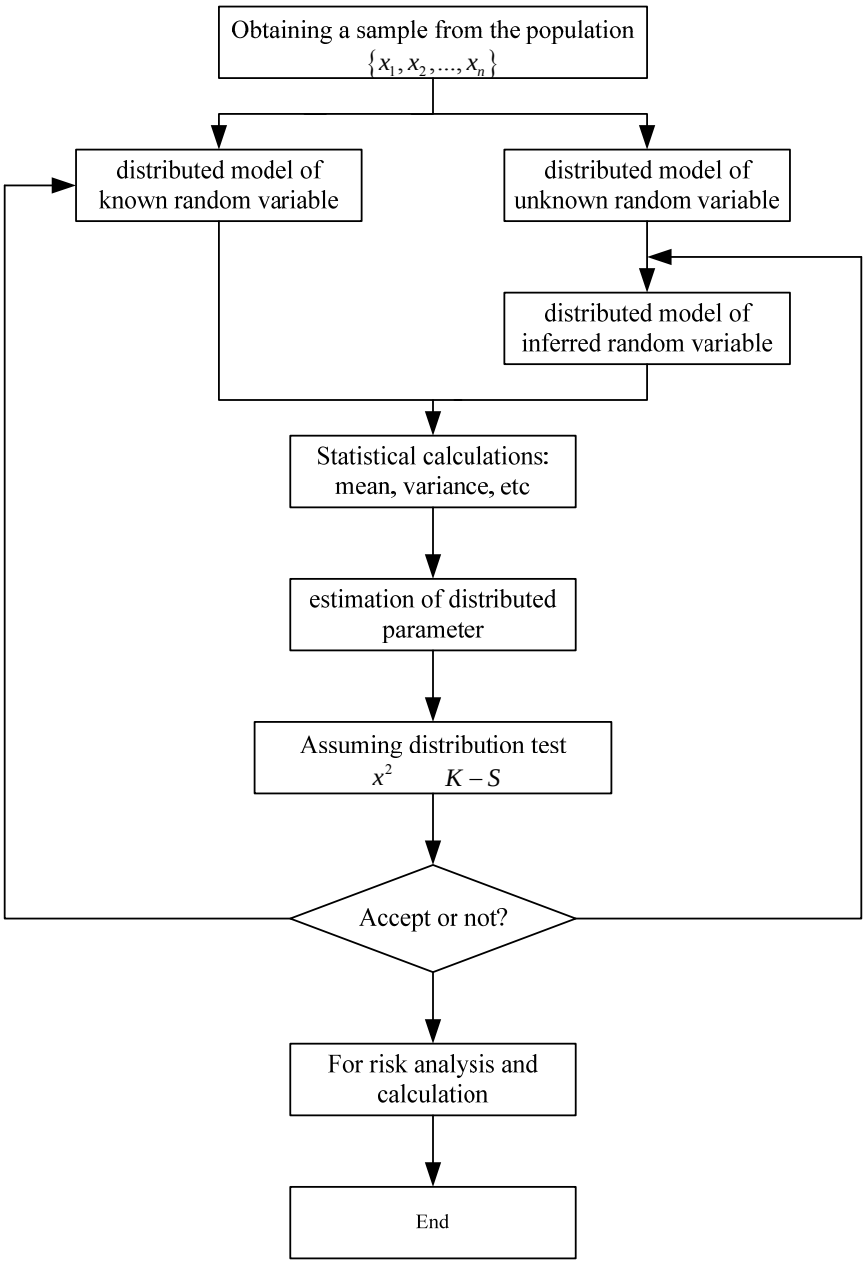

Figure 3 : General schematic random sample of statistical inference

THE ASSESSMENT OF MINING INVESTMENT RISK

The application of economic evaluation theory in the evaluation of mining investment risk

The assessment of mining project risk includes an analysis of qualitative and quantitative. Project cash flows' mathematical model required to accurately reflect the project's corresponding relationship of relevant variables and the impact on the system output values because of these variables' change.

The application of capital asset pricing model in mining risk assessment

Capital asset pricing model is widely used to determine the project discount rate approach in a mining project investment. In accordance with the basis of this model, the discount rate of the project, that the project cost of capital is recognized as a basis of low-risk investment rate of return on,it is a rational investment rate of return which will be adjusted according to the risk factors of specific projects.

The theory's assumptions of capital asset pricing model. The basic assumption in the process of capital asset pricing model, the first consideration is that the capital market with strong competitiveness, while making the investment process, not make much consideration for the relevant constraints. Secondly, making the continuous improvement of all the investment's pursue, and maximizing the vision of investment returns. And then establish a high-risk investment returns which is generated by the project will be more thought, finally, for all mining projects investors, making an asset in unified time for investment decisions.

The basic content of the course from the perspective of the capital asset pricing model,making the appropriate assumptions for their model, and then making the continuous improvement of the investment risk to get a higher return on capital interests. However, in the mining investment projects which is confronted with high risk, that should not be fixed in interest among the rightful return of interest, it should continue to improve earnings targets. In order to calculate the rates of investment income for specific mining projects, the computational formula should be:

$$R = R_f + Rate\ of\ \ risked\ \ return R_f + \beta(R_m - R_f)$$

However, in the formula, we can see that the meaning of R is not difficult to understand, so it need not be made too much explanation, in a simple word, the project should be yield[4]under the conditions of known risk investments (P). And R_f precisely represents the generation of the risk-free return on the funds. β referred to the correction coefficient of their existence in mining project risk, R_m is the average investment yield in capital markets. From what have been said that the particular formula should be:

$$\beta = \frac{Cov(R_f, R_m)}{\delta_m^2}$$

The statements in the above formula, R_f and R_m represents the covariance of efficiency of capital gains in the $R_f Cov\left(R_f, R_m\right)$, the variance of δ_m^2 - R_m , from the R into the net cash flow of present value of the formula in this project, we can obtain the following formula:

$$NVP = \sum_{t=1}^{n} \frac{NCF_t}{(1+k)^t - I}$$

$$NVP = \sum_{t=1}^{n} \frac{NCF_t}{(1+k)^t} - I = \sum_{t=1}^{n} \frac{NCFt}{\left[1 + R_f + \beta(R_m - R_f)\right]^t} - I$$

By corresponding calculation process, we can make the accurate calculations for the present value of net cash flow of specific risk factors which are existed in the mining project. The NPV's inherent meaning of the formula is the total of net cash flow which is generated by the cycle of the project life's economy in the first year of *t*. And NCF_r is a specific represents of net cash flow. *I* stands for the beginning of investment number in the projects, *T* represents the number of years, but the significance of *n* is the length of their own economic cycle in this mining project. While the beginning of investment number in the projects can be calculated on the following formula. And the specific formula is as follows:

$$I = \sum_{t=1}^{n} \frac{e_t}{(1+k)^t}$$

Among this: in the formula,the e_t stands for investment in the year of *t*. Thus we can know the following, if $NPV \geq O$, then the project can get R% of average earnings over the expected economic cycle, we can get excess profits which are deducted from the risk, proceeds of the project will be greater than or equal to the opportunity cost of the investment, if $NPV < 0$, the benefits of the project is less than the opportunity cost of the investment, the high cost of investment opportunities means that the high risk of benefit.

Fuzzy analysis of the degree of mining investment risk

Mining investment process exists many uncertainties, however, in the process of decision-making for mining investment, its risk factors are very difficult to find, the specific characteristics of the deposit of its existence can also not be identified in time. However, each statistical data requires making an investment before they are completely reflected. Due to

uncertainties in the presence of specific environmental investments, therefore, they will result certain risks in mining investment, and its output targets will also generate strong uncertainty [5].

Fuzzy Analysis of mining investment project risk

Conducting the process of mining investment project risk assessment, we need to make full use of fuzzy math method. And conduct a comprehensive assessment of the uncertainties which is generated by its affection. Make the existence of the state of risks have a basis on scientific and reasonable expression in mining investment projects.

Fuzzy analysis method of Mining Investment risk's assessment

First of all, making the factors of mining investment risk evaluation together and setting scientific construction, combined with the impact of mining investment projects of related risk factors for effective analysis, the factors represented by the letter U. The factor sets is constructed by the follows.

$$U = (u_1, u_2, ...u_n)$$

Among this, u_i its meaning lies in the *i-th* factors, and n means factor of the total, however, these factors usually will have different levels of fuzziness.

Secondly, make a corresponding to the establishment for the sets of weight. From the nature of the different factors to divide, the importance of each factor has varied. But during the analytical course of factors,important factor in its degree of attention should be different. Then in contrast to the factors with lighter importance should be appropriately considered within the scope. However, from the start of the importance of each reaction factors, it should be given to the corresponding weight,factors of this construction and the corresponding to the set of weights should be reasonably constructed. Here represented by *W*. Sets of weights are specifically established as follows:

$$\sum_{i=1}^{n} W_i = 1, W = (w_1, w_2, ...w_n)$$

Thirdly, the evaluation sets should be reasonably constructed. The evaluation sets were the core of the evaluation results of specific shows which were processed by commentors for each factor, they can effectively collect the structure of evaluation among the evaluation sets. The evaluation set is represented by the letter *P*, as follows:

$$P = (p_1, p_2, ..., p_m)$$

During the establishment of the evaluation, P_j 's own meaning is that the *j-th* evaluation results in the sets, and then *m* is referred to the total number of the evaluation results.

Fourthly, it is the response to expand fuzzy evaluation for a single factor. The related process of separate evaluation should start from one factor, which can effectively establish the membership of which is the evaluation object to the sets of evaluation, the evaluation process is often referred to fuzzy evaluation of single factor. Assuming that we are making the corresponding evaluation process for u_1 which is in the set of *i*. Then the r_{ij} is the membership of *j-th* factor (P_j) in the sets of evaluation, and then we are able to get the corresponding fuzzy sets in the process of evaluation for single-factor of u1 can,the specific formula as follows:

$$R_i = (r_{11}, r_{12}, ...r_{1m})$$

However, after processing the related evaluation of all single factors through what have been said, we can establish the corresponding evaluation matrix, the specific information as follows:

$$R = \begin{bmatrix} R_1 \\ R_2 \\ R_3 \\ ... \\ R_n \end{bmatrix} = \begin{bmatrix} r_{11} & r_{12} & r_{13} & ... & r_{1m} \\ r_{21} & r_{22} & r_{23} & ... & r_{2m} \\ r_{31} & r_{32} & r_{33} & ... & r_{3m} \\ ... & ... & ... & ... & ... \\ r_{n1} & r_{n2} & r_{n3} & ... & r_{nm} \end{bmatrix}$$

Finally, it's turn to carry out on the matrix of fuzzy evaluation process. Make a comprehensive consideration of all factors from the influencing factors, which can get a scientifically reasonable conclusion of evaluation, the fuzzy evaluation process must be a step through this process. As follows:

$$B = W \bullet R = (b_1, b_2, ...b_m)$$
$$= (w_1, w_2, ..., w_n) \begin{bmatrix} r_{11} & r_{12} & r_{13} & \cdots & r_{1m} \\ r_{21} & r_{22} & r_{23} & \cdots & r_{2m} \\ r_{31} & r_{32} & r_{33} & \cdots & r_{3m} \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ r_{n1} & r_{n2} & r_{n3} & \cdots & r_{nm} \end{bmatrix}$$

$$b_j = \sum W_i \bullet r_{ij}, \; j = 1, 2, ..., m$$

The evaluated research of economic strength in Mining Project Process

During the evaluated research of economic strength in Mining Project Process, the main index of evaluation mainly includes several aspects, that will be able to promote its scientific evaluation of mining projects continue to reduce the risk of cross-border investment, and then achieving the rationalization of investment process,specific indicators and evaluation of the research process as follows

The rate of debt coverage in mining project

The so-called rate of debt coverage in mining project is that the specific ratio between its cash flow and debt repayment obligations in related mining projects. however, the rate of debt coverage in mining project are specifically divided into two indicators, the first is a single annual rate of debt coverage, while the other is cumulative rate of debt coverage[6]. First, the method for calculating the single annual rate of debt coverage is as follows:

$$DCR_t = \frac{NCF_t + RP_t + IE_t + LE_t}{RP_t + IE_t + LE_t} = 1 + \frac{NCF_t}{RP_t + IE_t + LE_t}$$

Among the formula, we can know the flow of project net cash in the year of t from NCF_t; while the RP_t is referred to the principal amount of expiring debt during the year of *t*; IE_t specifically referring that we should pay total interest of debts in the year of t. Intrinsic meaning of LE_t is the sum of the lease payments payable in the project during the year the t's. However, the method of a total debt coverage rate in mining projects usually use $\sum DCR_t$ to express, and specific operational procedure can be seen clearly by the following formula.

$$\sum DCR_t = (NC_t + RP_t + IE_t + LE_t + \sum_{i=1}^{t-1} NCF_i) / RP_t + IE_t + LE_t$$

Sustainability ratios of project debt

Withstand the proportion of definitions from mining projects, the so-called ratio of eye-catching debt city is the ratio which between the flow of cash and the loan of cash. It is usually based on the CR to reflect, however, the formula is:

$$CR = \frac{PV}{D}$$

Not pay much emphasis on CR among the formula, its meaning is obvious. The PV's own meaning is processing the discount rate of risk correction to calculate the specific value in the mining project financing process,, and the D stands for the total number of specific funds which are planned to loan.

Reserves Coverage Rate (RCR).

The reserve coverage rate is calculated as:

$$PCR = \frac{\text{preserving of reserves}}{\text{plan for exploitation, reserving during the project financing}}$$

Reserves Return Coverage Rate (RRCR).

The reserves return coverage rate's computational formula is:

$$PRCR = \frac{PVNP_t}{OD_t}$$

However, in the process of citing from the above formula, PRCR is not needed too much description,that is the reserves return coverage rate within the year of t. And OD_t generally referred to the total investment amount of debt which is asked for reimbursement in the year of *t.* Then the specific meaning of $PVNP_t$ is the much value of specific reserves which are contained in the untapped mining during the year of *t.* And then the specific formula is as follows:

$$PVNP_t = \sum_{i=1}^{N} \frac{NP_i}{(1+R)^i}$$

Which can be seen from the above formula, n represents the sustain life cycle in this mining project, and R reflected the discount rate in the process of project investment, NP_i is referring to the number of gross profit which are generated in this mining project in the year of *t*. Through making the evaluation of economic strength's research process from the above process of mining project, and then making China's mining enterprises can scientifically computing its risk index in the process of cross-border investment, which gradually increasing the grasp of its investment process, and ultimately makes the investment in mining projects to achieve maximum benefits[7].

CONCLUSIONS

From above all, the article provide related research and exploration process for investment risk index of multinational mining companies in China, combined with the establishment of capital asset pricing model and the effective use of fuzzy math method, providing a solid theoretical foundation for scientific computing of multinational mining companies' investment risk index. Make the effective research for the evaluation of economic strength of its mining projects in this process, and then deeply developing the research process of mining enterprises' transnational investment risk index. Moreover, providing strong support for the mining companies to maximize the interests of transnational investment.

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