

# Integration of ESG Factors in China's Coffee Industry and Identification of Financial Risks

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**Abstract:** With the increasing concern for sustainable development in the world, ESG (environmental, social and corporate governance) factors are playing a more and more important role in enterprise management. The purpose of this study is to explore the influence of the integration of ESG factors in China's coffee industry on financial risk identification. By systematically integrating ESG factors such as environmental friendliness, social responsibility and corporate governance, we build a comprehensive financial risk assessment model to identify the potential risks faced by coffee enterprises more comprehensively and accurately. In the method, CatBoost algorithm is used to identify financial risks, and ADASYN algorithm is used to optimize the training set to improve the sensitivity of the model to default risks. The research results show that through the integration of ESG factors, our model has achieved remarkable results in financial risk identification. The Accuracy value reached 0.9671, 12 out of 15 default samples were accurately predicted, and the identification of non-default companies also had strong accuracy, only 2 of them were misjudged. This shows that ESG factors not only have an important impact on sustainable management in the coffee industry, but also can provide strong support for enterprises in identifying financial risks.

**Keywords:** Financial Risks, ESG Factors, China's Coffee Industry.

## 1. Introduction

In today's global economic structure, ESG (environmental, social and corporate governance) has become one of the key factors in the operation and development of enterprises. Especially in China, a country where coffee industry is booming, the integration of ESG factors is very important for the long-term sustainable development of enterprises. Different from traditional financial indicators [1], it can reflect the performance of enterprises in environmental protection, social responsibility and corporate governance, and help investors understand the sustainable development of enterprises and their social values. With the increasing concern of society for environmental, social and governance issues, it has become an important strategic move for enterprises to integrate ESG factors into the coffee industry.

As one of the most important agricultural products in the world, coffee industry has made remarkable growth in China in recent years, but it is also accompanied by a series of social and environmental challenges. Environmental pollution, social equity, ecological balance and other issues have aroused widespread concern, and these issues have a direct impact on the sustainability and financial stability of the coffee industry [2-3]. Therefore, this paper will deeply study the integration of ESG factors in China's coffee industry and explore its role in financial risk identification. Through the research of this paper, we aim to provide practical suggestions for enterprises in China's coffee industry to better understand and cope with the influence of ESG factors on financial risks, so as to achieve sustainable economic growth.

## 2. ESG factor analysis of financial risk of Chinese coffee industry

Under the background of the rapid development of China's coffee industry, ESG factors play an increasingly prominent role in financial risk analysis. As an industry closely linked with natural environment and social culture, coffee industry's

business activities are directly influenced by ESG factors.

### (1) Environmental factor

Coffee production is closely related to the environment, including land use, water resources management and the use of chemicals. Environmental problems may lead to the instability of production costs, such as unpredictable climate events caused by climate change, which may lead to fluctuations in coffee production [4]. If enterprises fail to effectively cope with environmental challenges, they may face financial risks such as insufficient supply of raw materials, production interruption and changes in environmental laws and regulations.

### (2) Social factor

Social responsibility in the coffee industry involves a wide range from coffee farmers to employees. Social factors such as labor rights, community participation and supply chain transparency are directly related to the reputation and brand value of enterprises. Financially, poor social performance may lead consumers to distrust brands, reduce sales, and even face legal responsibilities, increasing the financial burden of enterprises.

### (3) Corporate governance factors

Strengthening corporate governance is the basis to ensure the long-term success and financial stability of enterprises. In the coffee industry, corporate governance issues may involve financial transparency, protection of shareholders' rights and interests and corruption risks [5-6]. Lack of effective corporate governance structure may lead to internal out-of-control, financial irregularities and legal responsibilities, and then have a negative impact on the financial situation of enterprises.

The comprehensive analysis of ESG factors is very important for a comprehensive understanding of financial risks. Enterprises need to carefully assess the environmental impact of their production and supply chain, actively participate in the community and improve the welfare of employees, and at the same time strengthen the corporate governance system to ensure the transparency and fairness of

enterprise decision-making. Through the comprehensive management of ESG factors, enterprises can better cope with financial risks and improve the long-term sustainability of their business.

In the future, with the strengthening of ESG investment trend and the increasing emphasis of society on corporate responsibility, enterprises in the coffee industry will inevitably be bound by stricter ESG standards. Therefore, actively dealing with ESG factors will not only help to enhance corporate image, but also effectively reduce financial risks and lay a solid foundation for the sustainable development of the coffee industry.

### 3. Integration and Financial Risk Identification Scheme in China's Coffee Industry

In this paper, when constructing the scheme index system, ESG index which can reflect corporate environmental responsibility, social responsibility and governance

responsibility is added on the basis of considering traditional factors, so as to enhance the model's ability to identify the default risk of corporate bonds [7]. In terms of algorithm selection, Catboost (Categorical Boosting) algorithm, as a new algorithm emerging in recent years, has better performance than other models in predicting deviation. Therefore, this paper takes it as the main algorithm to build a financial risk identification model of coffee companies with ESG information [8-9].

Financial indicators are the most direct information to measure the company's operating conditions. By analyzing and refining the relevant subjects of the company's financial statements, with the help of relevant knowledge of financial ratios, investors can obtain information such as the company's solvency, profitability, operational capacity and growth capacity, which has a very significant effect on identifying the company's default risk. Based on the comprehensive analysis of traditional indicators and ESG indicators, the index system is constructed as shown in Figure 1 below:

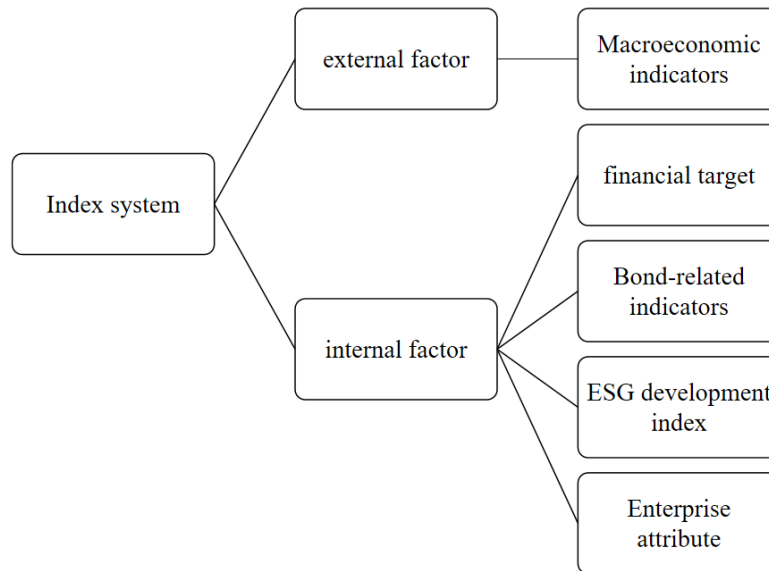


Figure 1. Index system of corporate bond default risk identification scheme integrated with ESG information

With the increasing emphasis on corporate social responsibility and sustainable development, the processing and quantification of ESG indicators has become a key aspect for enterprises to evaluate and demonstrate sustainability. Effective ESG indicator management can not only help enterprises identify potential risks and opportunities, but also enhance the transparency of enterprises and enhance the trust of stakeholders. Enterprises should define their ESG indicator framework to ensure comprehensive coverage of three major areas: environment, society and corporate governance. Effective ESG index processing is inseparable from reliable data [10].

Enterprises need to establish a sound data collection mechanism and integrate internal and external data sources to ensure the accuracy and real-time performance of data. This may involve collaboration with supply chain partners, communities and other stakeholders. The establishment of a comprehensive evaluation system will help enterprises to achieve better communication with stakeholders, promote the benign interaction between ESG practice and financial performance, and move towards a more sustainable future.

The processing and quantification of ESG indicators usually involves data collection and integration in multiple dimensions, weight distribution, and comprehensive scoring.

Calculation formula of environmental (E) index:

$$E\_Score = E1\_Weight \times E1\_Performance + (E2\_Weight \times 2\_Performance) + B + (En\_Weight \times En\_Performance) \quad (1)$$

Among them,  $E\_Score$  is the environmental score,  $Ei\_Weight$  is the weight of the  $i$  environmental factor, and  $i$  is the performance score of this factor. Through this formula, different environmental factors can be weighted and summed according to their importance to form the overall environmental score.

Social (S) index calculation formula:

$$S\_Score = (S1\_Weight \times S1\_Performance) + (S2\_Weight \times S2\_Performance) + B + (Sn\_Weight \times Sn\_Performance) \quad (2)$$

Similarly,  $S\_Score$  is the social score,  $Si\_Weight$  is the weight of the  $i$  social factor, and  $Si\_Performance$  is the

performance score of this factor. The calculation of social score also reflects the contribution of social factors to the comprehensive ESG score by weighted summation.

Calculation formula of corporate governance (G) index:

$$G\_Score=(G1\_Weight \times G1\_Performance)+(G2\_Weight \times G2\_Performance)+B + (Gn\_Weight \times Gn\_Performance) \quad (3)$$

The calculation method of corporate governance score  $G\_Score$  is similar to that of environmental and social scores, which reflects the overall performance of corporate governance factors through the weighted sum of weights and performance scores.

The ESG index selected in this paper divides the company's ESG rating into 10 grades by comprehensively evaluating the indicators according to the above methods. In this paper, A+ is defined as 100 points, and other ratings are analogized.

CatBoost is a machine learning algorithm based on gradient lifting framework, which is specially used to deal with problems with classification characteristics. It was developed by Yandex to provide a high-performance, accurate and interpretable machine learning model. CatBoost is outstanding in dealing with large-scale data and complex models, especially in the fields of finance, e-commerce and advertising. As a powerful gradient lifting framework, CatBoost provides a convenient and efficient tool for solving practical problems through its unique ability to handle classification features, high performance and automatic parameter adjustment function. Its application in practice has achieved remarkable results, and it has become a powerful tool to deal with complex data sets and improve prediction performance.

First, collect the financial data related to China's coffee industry and integrate the data related to ESG factors. Including environmental carbon emissions, water resources management, social employee rights and interests, community participation, as well as corporate governance transparency, board structure, etc. Carry out data cleaning, missing value processing and feature engineering to ensure data quality and availability. For CatBoost algorithm, there is no need to do too much feature engineering on the data, but it is necessary to ensure that the data set contains target variables (labels of financial risks) and input features (including financial indicators and ESG factors). For the classification problem, it is necessary to code the financial risk label. The data set is divided into training set and test set, so that its performance can be verified after model training. CatBoost algorithm is used for model training. In the process of model training, financial data and ESG factors are taken as input features, and financial risk labels are taken as target variables. Set appropriate hyperparameters, such as learning rate and iteration times, to ensure the performance and

generalization ability of the model.

## 4. Result Analysis

In this paper, according to the similar industry proportion of default samples, 185 non-default corporate bonds issued by Chinese coffee enterprises are selected as control samples according to the ratio of 70-30, and corporate bonds are combined with normal corporate bonds according to the ratio of 70-30 to get a training set, and the default corporate bonds are combined with normal corporate bonds according to the ratio of 70-30 to get a test set. The training set contains 114 samples and the test set contains 86 samples.

In this paper, ADASYN algorithm is selected to optimize the training set, so that the ratio of positive and negative samples is 1:1. For the abnormal values in the sample data, this paper adopts a method similar to the vacancy value, that is, it replaces the average value of the industry where the corporate bond issuer is located to complete the data cleaning.

The data of training set is optimized by ADASYN algorithm, and the optimized training set is put into the model. Put the test set into the trained model to get the confusion matrix of the model as shown in Figure 2 below:

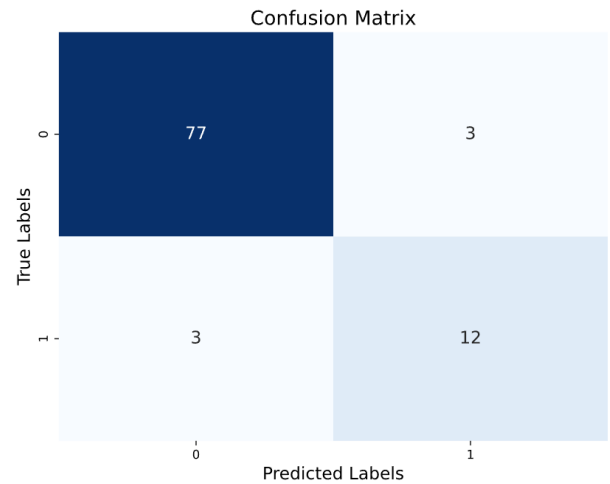


Figure 2. Model confusion matrix

It can be seen that the model has a strong prediction ability for corporate bonds in default, and the Accuracy value is 0.9671, and 12 of the 15 default samples are predicted, and the model also has a strong recognition ability for non-default samples, and only 2 of the 80 corporate bonds without default are misjudged.

In order to further analyze the performance of the model, this paper calculates four evaluation indexes of the model as shown in Table 1 below:

Table 1. Model evaluation index

AUC	Precision	Recall	F1
0.899	0.824	0.879	0.887

It can be seen that the AUC value of the model is 0.899, and the closer the AUC value is to 1, the better the performance of the model, which shows that this model has a strong ability to identify the default risk of corporate bonds. The Precision value of the model is 0.824, which means that only 82.4% of the bonds predicted to be in default are actually in default, indicating that the misjudgment rate of the model

for non-default samples is low, and the larger the value, the better, and 0.7 is a good result.

To sum up, compared with the traditional integrated learning scheme, the Catboost scheme has higher performance, and the model can identify the default corporate bonds very well. Catboost algorithm shows the best performance when constructing the financial risk

identification model of coffee company, which proves the rationality of this paper as the main model.

## 5. Conclusions

In the current global scope, ESG factor has gradually become an important factor that can not be ignored in enterprise development and investment decision-making, especially for Chinese coffee industry. The sustainable development of coffee industry depends not only on financial performance, but also on the commitment of enterprises to environmental friendliness, social responsibility and good governance. By incorporating ESG factors into the financial risk assessment model, we can not only understand the risk faced by enterprises more comprehensively, but also predict potential financial problems more accurately. The accuracy of the model has been verified in the testing stage, and its sensitivity to default risk and accurate identification of non-default companies make it a strong support for risk management tools. By incorporating ESG factors into business decisions, enterprises can better meet the growing social expectations, establish a sustainable business model, and provide creating shared value for investors, consumers and society.

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