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Construction and Application of Financial Risk Warning System for Third-Party Payment Enterprises Based on Z-Score Model and Efficacy Coefficient Method

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Abstract: *With the rapid development of e-commerce, third-party payment enterprises play a crucial role in modern financial ecology. The accompanying financial risks are also increasingly prominent, and the traditional risk assessment methods are difficult to meet the market's demand for real-time monitoring and early warning. Based on Z-Score model and efficiency coefficient method, this paper discusses the effectiveness of building financial risk early warning system of third-party payment enterprises. First of all, Z-Score model can effectively predict the probability of enterprise bankruptcy through comprehensive analysis of key indicators in financial statements. The core of the model lies in the reasonable use of liquidity, profitability and financial leverage. By weighting the importance of different financial indicators, including data collection, indicator selection and model construction, the efficiency coefficient method provides a multi-dimensional evaluation framework, and finally realizes the comprehensive monitoring of the financial status of enterprises. Regular calculation of Z-Score value and combined with efficiency coefficient method for risk assessment can provide timely early warning information for third-party payment enterprises, so as to help enterprises develop more effective risk management strategies. The research in this paper not only provides theoretical support for the risk management of the third-party payment industry, but also provides practical suggestions for the actual operation of related enterprises, which has important application value and practical significance. In the future, combined with big data and artificial intelligence technology, the accuracy and applicability of the financial risk early warning system will be further improved, providing a strong guarantee for the healthy development of the industry.*

Keywords: *Z-Score model, Efficiency coefficient method, Financial risk, Third-party payment, Early warning system*

1. Introduction

With the rapid development of global e-commerce and digital pay, third-party payment enterprises occupy a pivotal position in modern economic system, greatly changed the traditional way of payment and the user experience. With the continuous expansion of the market and the increasingly fierce competition, the financial risk of the third-party payment enterprises has become more and more prominent. In recent years, a number of third-party payment companies have caused industry volatility due to financial crisis, and investors and regulators have increasingly paid attention to the financial health of the industry.Therefore, building a scientific, reasonable and forward-looking financial risk early warning system has become a necessary measure to maintain the steady development of third-party payment enterprises. The traditional financial risk early warning system is mainly based on financial statement analysis and financial ratio method. However, in practical application, the asset structure, income source and business model of third-party payment enterprises are unique, and such traditional analysis methods are difficult to accurately reflect their risk status. In order to capture the financial volatility of third-party payment enterprises effectively, this paper introduces Z-Score model and efficiency coefficient method. Compared with other traditional methods, Z-Score model has higher prediction accuracy and wide applicability, and is widely used in financial risk early warning in many fields. As a multi-index evaluation method, the efficiency coefficient rule can fully consider the importance and contribution of each financial index, and make up for the deficiency of Z-Score model in evaluation flexibility.By using these two models, this paper constructs a financial risk early warning

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system suitable for third-party payment enterprises, which can not only identify potential financial crises, but also provide data support for enterprise risk management and decision-making.

2. Theoretical basis

2.1 Z-Score model

The Z-Score model, the Altman Z-Score model, is a corporate bankruptcy prediction model proposed by American financial scholar Edward Altman in 1968. The model is based on key financial indicators in a company's financial statements and uses a multivariate discriminant analysis method to construct a weighted formula to measure the financial health of the company and its bankruptcy probability. The core of the Z-Score model is to construct a comprehensive scoring system using five financial ratio indicators, and the calculated Z-Score can be used as a reference standard for evaluating the financial status and bankruptcy risk of a company. Its calculation formula is as follows:

$$Z=1.2\times X_1+1.4\times X_2+3.3\times X_3+0.6\times X_4+1.0\times X_5 \quad (1)$$

Among them:

X_1: Current assets/total assets, used to measure the short-term solvency of enterprises;

X_2: Retained earnings/total assets, reflecting the accumulation of profits and the ability to resist risks;

X_3: Ebit/total assets to assess the operating profitability of the enterprise;

X_4: The market value of shareholders' equity/total liabilities indicates the stability of the capital structure of the enterprise;

X_5: Sales revenue/total assets, indicating the turnover efficiency of enterprise assets.

Z-Score model is weighted by different indicators to form a comprehensive score, reflecting the financial health of enterprises.

2.2 Efficiency coefficient method

The efficacy coefficient method is a frequently employed approach in multi-index evaluation and decision-making analysis. Its core notion lies in quantifying the relative significance of diverse indicators to furnish a foundation for comprehensive assessment. In financial risk evaluation, given that a solitary financial ratio is incapable of comprehensively mirroring the overall financial condition of an enterprise, the introduction of the efficacy coefficient method becomes especially crucial. This method constructs a set of weight systems to rationally allocate the weights of various financial indicators, with the aim of attaining a more precise evaluation of the enterprise's financial health status.

The fundamental steps of the efficacy coefficient method encompass indicator selection, weight determination, score calculation, and result analysis. Researchers are obliged to select a series of representative financial indicators based on the characteristics of the enterprise and the industry backdrop, such as the current ratio, the asset-liability ratio, the profit margin, the cash flow ratio, and so forth. The weights of each indicator are ascertained through methods like expert interviews, questionnaire surveys, or historical data analyses. This weight allocation process assesses the contribution and influence of each indicator on financial health, enabling more significant indicators to occupy a larger proportion in the overall score.

After the determination of weights, the efficacy coefficient method computes the comprehensive score via the weighted average approach. The specific formula is as follows:

$$\text{Comprehensive score} = \sum(\text{weight}_i \times \text{indicator}_i) \quad (2)$$

Here, weight_i represents the weight of the i-th indicator, and indicator_i is the actual value of that indicator. This score can not only serve as a quantitative indicator of the enterprise's financial risk but also offer significant reference for the enterprise's financial decision-making. In practical applications, the efficacy coefficient method can effectively integrate multi-dimensional financial information and overcome the limitations of single indicator evaluation. The management of the enterprise can promptly identify latent financial risks, adopt corresponding countermeasures, optimize the financial structure, and enhance the efficiency of capital utilization. Hence, the efficacy coefficient method plays

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an indispensable role in constructing the financial risk early warning system of third-party payment enterprises.[1]

3. Financial risk early warning system design

3.1 Data collection

In the construction of financial risk early warning system of third-party payment enterprises, data collection is the first step of system design, and it is also a key step that affects the accuracy and effectiveness of subsequent analysis. Effective data collection needs to systematically cover the company's financial information, industry dynamics and market data, and accurately depict the financial situation from multiple angles and in all aspects. The collected data is mainly divided into three categories: financial data, non-financial data and external market data.[2]

Financial data is the core of risk early warning system, including key financial indicators in balance sheet, income statement and cash flow statement. Current ratio, quick ratio, asset-liability ratio and other indicators that reflect short-term solvency, as well as indicators that show profitability such as return on total assets and sales profit rate should be paid attention to. The operating cash flow, investment cash flow and other data in the cash flow statement are also crucial to measure the cash liquidity and short-term financial stability of an enterprise. These data can provide the core support for the calculation of Z-Score model, and also provide the basis for the multi-indicator evaluation in the efficiency coefficient method.

Non-financial data are equally important in risk warning systems. The operation status of third-party payment enterprises is not only affected by financial status, but also closely related to non-financial indicators such as transaction activity, user growth rate and market share. These indicators reflect the enterprise's market position and business expansion ability, and are an important basis for judging the future growth and potential risks of the enterprise. In the digital payment industry, changes in user activity and market share can directly affect the income structure and cash flow of enterprises, and it is necessary to systematically collect non-financial data to facilitate the combination of quantitative analysis and qualitative judgment in the evaluation to improve the early warning sensitivity of the model.

External market data cannot be ignored either. The financial health of third-party payment enterprises is closely related to external factors such as market interest rate, macroeconomic situation and industry competition. In the process of data collection, it is necessary to pay attention to external data such as central bank interest rate policy, industry growth rate, financial regulatory policy, and consider the financial performance of enterprises in the same industry. [3]

3.2 Index selection

In the construction of financial risk early warning system of third-party payment enterprises, the selection of indicators is the key link of system design. In order to accurately reflect the financial status and potential risks of enterprises, representative financial indicators should be selected on the basis of comprehensive analysis of the characteristics of the third-party payment industry. These indicators should not only reflect the liquidity, profitability and liabilities of enterprises, but also have good forecasting effect to achieve early warning of financial risks.

For third-party payment enterprises, their cash flow is highly volatile, and paying attention to liquidity indicators can effectively prevent financial crisis caused by short-term liquidity shortage.

Profitability metrics are also indispensable. Such indicators include return on equity (ROE) and net profit margin on sales. The return on equity can reveal the earning ability of an enterprise through its own capital, while the net profit rate of sales reflects the proportion of sales revenue that can form actual profits. Both of them can directly show the core earnings status of an enterprise. The profit model of third-party payment enterprises depends on the transaction volume and payment fees, and the profit level is affected by market competition and policy supervision. It is necessary to incorporate the profitability index into the risk early warning system to evaluate the stability of sustainable profit.[4]

Metrics of leverage and operational efficiency are also essential. Leverage indicators such as asset-liability ratio can assess the long-term solvency and financial risk level of enterprises; For third-party payment enterprises with light asset structure and fast capital flow, the high level of this

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index increases the pressure of debt repayment, and it is easy to cause financial risks when the macroeconomic or regulatory environment changes. Operational efficiency indicators, such as total assets turnover and accounts receivable turnover, can reveal the efficiency of asset use and collection of enterprises, help evaluate the capital flow speed of operating activities, and identify the shortage of working capital in advance.[5]

To construct the financial risk warning system of third-party payment enterprises, it is necessary to comprehensively consider the key financial indicators such as liquidity, profitability, leverage level and operational efficiency. By combining Z-Score model and efficiency coefficient method, different weights are assigned to each index. It can reflect the financial health of enterprises more objectively and accurately, and provide scientific guidance basis for the financial risk management of enterprises.

3.3 Model construction

When constructing the model of the financial risk early warning system for third-party payment enterprises, multiple factors such as the financial structure, operational characteristics, and market environment of the enterprises should be comprehensively considered to achieve a multi-dimensional assessment of financial risks. This paper employs a multi-model comprehensive method combining the Z-Score model and the efficacy coefficient method, aiming to enhance the capture ability of financial risks and improve the accuracy and applicability of the early warning model.

The Z-Score model, as the foundation of financial risk assessment, quantifies the bankruptcy probability of an enterprise through the weighted summary of a series of key financial ratios. The five main financial ratio indicators in the Z-Score formula, namely, the ratio of current assets to total assets (X1), the ratio of retained earnings to total assets (X2), the ratio of earnings before interest and tax to total assets (X3), the ratio of market value to total liabilities (X4), and the ratio of sales revenue to total assets (X5), are all comprehensive manifestations of the enterprise's liquidity, profitability, market value, and asset operating efficiency. Analyzing these indicators can clearly delineate the financial situation of the enterprise and its potential bankruptcy risks. The Z-Score value of each sample enterprise is calculated using historical data, and its financial health status is preliminarily classified accordingly.

Efficiency coefficient method is used to optimize the index weight of Z-Score model, so that the model is more in line with the business characteristics of third-party payment enterprises. The efficiency coefficient method can dynamically adjust the indicators in Z-Score according to the actual importance and sensitivity of each financial indicator in enterprise operation, and give each indicator a reasonable weight. This empowerment mechanism not only improves the flexibility and accuracy of the model, but also makes the model better adapt to the unique financial risk characteristics of the third-party payment industry, such as higher capital liquidity and risks caused by user funds precipitation.[6]

In practice, the score calculated by Z-Score is used for preliminary screening of financial health, and the efficiency coefficient rule classifies financial status into different risk levels through comprehensive consideration of the importance of various financial indicators. In order to improve the accuracy of the early warning system, the stability and accuracy of the model can be tested by backtesting historical data, and the rolling prediction mechanism can be introduced to dynamically track the financial changes of enterprises. Through the dual function of Z-Score model and efficiency coefficient method, the system can not only identify the current financial risk, but also predict the possible risk trend in the future, and provide effective data support for the financial management and strategic decision-making of enterprises.

4. Risk early warning mechanism

In building a financial risk warning system for third-party payment enterprises, the risk warning mechanism is the core link, aiming to identify and warn potential financial risks through real-time monitoring and analysis of financial data. This mechanism not only helps enterprises identify risks in the early stages, but also provides effective decision support for management to maintain long-term stable development.

The foundation of the risk warning mechanism is dynamic monitoring of the financial health of the enterprise. Based on the Z-Score model, the financial data of the enterprise will be regularly updated. By comparing historical data to identify trend changes, when the Z-Score value of the enterprise

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continues to decline significantly, an alarm can be issued. According to the specific threshold value of Z-Score, the enterprise can be divided into different risk grades: Z>2.99 indicates that the enterprise's financial condition is good and is in the safe zone; 1.81 < Z < 2.99 is in the warning zone, indicating that the enterprise needs to strengthen monitoring and management; while Z < 1.81 enters the dangerous zone, indicating that the enterprise faces a high risk of bankruptcy.

Combining the advantages of the efficiency coefficient method, the warning mechanism is not limited to the single analysis of Z-Score value, but also needs to comprehensively evaluate multiple financial indicators. Setting the efficiency coefficient of each indicator can quantify the degree to which different indicators affect the financial health of the enterprise. The changes of liquidity ratio, asset-liability ratio, net profit margin, etc. will be assigned different weights to help management have a more comprehensive understanding of the enterprise's financial situation. This method can effectively identify the most significant risk factors that affect the enterprise in a specific economic environment and provide direction for subsequent risk management.[7]

The warning mechanism should have a flexible response mechanism. Once the warning signal is triggered, the enterprise should immediately initiate risk response measures, such as strengthening cash flow management, optimizing financing structure, or adjusting operational strategies, to reduce potential financial risks. The enterprise should regularly conduct financial health checks and analyze the causes of risks to formulate long-term risk prevention and control strategies.

It is necessary to establish an effective information sharing platform, strengthen the coordination and cooperation between departments, ensure that risk warning information is communicated to the relevant management in a timely manner, and form a cultural atmosphere [8].

5. Conclusion and prospect

Through the combination of Z-Score model and efficacy coefficient method, this paper builds a financial risk early warning system suitable for third-party payment enterprises. Z-Score model can effectively quantify the financial health level of enterprises and provide accurate forecasting tools for evaluating the possibility of bankruptcy and financial risk of enterprises. As a multi-index evaluation model, efficacy coefficient method makes up for the deficiency of Z-Score model in index flexibility. The combination of the two can realize the comprehensive and dynamic assessment of the financial health of enterprises, and improve the accuracy and timeliness of financial risk early warning.

The early warning system not only provides enterprises with real-time financial risk monitoring means, but also provides powerful data support for their management and investors in risk control and investment decisions. The calculation results of Z-Score model provide a standardized evaluation basis for the comparison of financial conditions between different enterprises, while the weight setting of efficacy coefficient method can adjust the risk determination criteria according to different financial structures, enhancing the adaptability and accuracy of the system.

With the rapid development of technology, financial risk early warning system can combine these technologies to build a more intelligent and dynamic risk early warning model. The system can automatically update the risk determination criteria through the deep mining of historical financial data and pattern recognition by machine learning algorithm to cope with the changing external environment. The introduction of blockchain technology enhances the transparency and authenticity of financial data, reduces the possibility of financial data fraud, and improves the reliability of early warning systems. With the continuous innovation in the field of financial technology, the future financial risk early warning system will provide more refined risk analysis and personalized early warning services, providing a solid guarantee for the sustainable development of third-party payment enterprises.

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