Research on enterprise financing credit based on soft and hard information under the background of blockchain --Take high-tech enterprises in Anhui Province as an example

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ABSTRACT

Under "accelerating the formation of a new development pattern of domestic circulation and domestic and internationaldouble circulation mutually promoting", high-tech enterprises, as an important role in promoting scientific and technological innovation and economic development, are facing the dilemma ofdifficult and expensive financing. This paper establishes acharacteristic evaluation and credit guarantee systembased on big data credit model to explore the difference ofsoft and hard informationon financing of high-tech enterprises in Anhui Province under the background of double circulation. Taking 131 high-tech enterprises in Anhui Province as samples, this paper analyzes the influence of unstructured soft information and structured hard information on credit evaluation and its intensity byhierarchical linear regression model. The results show that soft and hard information indexes have significant positive effects on credit risk of high-tech enterprises, and soft information has more obvious effects on small and medium-sized high-tech enterprises.

KEYWORDS

Double cycle; Enterprise credit risk; Hierarchical linear regression model; Soft information; Hard information

1. INTRODUCTION

1.1. Research Background

Under the background of current double-cycle system, high-tech enterprises will usher in a strategic development opportunity period. However, as the main force of double-cycle development, one of the main difficulties of high-tech enterprises at present is financing difficulty. Relevant policies should promote emergency measures while assisting the construction of long-term mechanism of enterprises, and establish a new double-cycle enterprise financing credit guarantee system based on digital technology.

1.2. literature Review

People from all walks of life and scholars from different angles on the financing of small and medium-sized high-tech enterprises have different management system research. Zhao Weiwei (2021) [1] pointed out that the main reason for the financing difficulties of SMEs lies in the unreasonable financing structure and single financing structure of SMEs themselves, and proposed an evaluation guarantee system based on enterprise credit system; Lu Yajuan et al.(2021) [2] believed that the new double-cycle development mode of SMEs was generated under the counter-current effect of shrinking external demand, international trade friction and economic globalization, and constructed an

operation index measurement model for small and micro enterprises; Wang Lihui et al.(2021) [3] believed that there were generally differences in the interest demands of different participants in science and technology financing, especially the credit level of technology-based SMEs still needs to be improved.

2. THEORETICAL ANALYSIS AND HYPOTHESIS FORMULATION

Hard information and soft information are equivalent to financial information and non-financial information respectively. Lin Yifu(2008) [4] pointed out that" hard information" usually refers to statements, tangible collateral and legal forms of guarantee contracts;" soft information" usually refers to information that is difficult to quantify, intangible assets and non-legal forms of constraints, such as blood relations and trade relations between people, borrower's ability to work, borrower's experience and reputation, and related games.

Based on this, this paper puts forward hypotheses to solve the following three problems: (1) whether the soft information and hard information of high-tech enterprises can positively enhance the credit evaluation of enterprises? (2) What kind of information is more valuable for the promotion of credit evaluation of small and medium-sized high-tech enterprises? How do they differ? Is there substitution or complementarity? (3) How does firm size affect the role of soft information?

2.1. The Relationship between Soft Information and Hard Information Pair and Credit Evaluation of High-tech Enterprises

If the soft information index is good, it can be considered that the enterprise is full of social responsibility, honest and trustworthy, and has a good image among the upstream and downstream traders, and the credit risk of the enterprise is low; if the hard information index is good, it can be considered that the enterprise has good strength and good cash flow performance. The smaller the business risk of the enterprise, the lower the credit risk.

H1: Soft and hard information positively regulate the credit evaluation of high-tech enterprises

2.2. Performance under different information mechanisms

Traditional institutions pay more attention to the analysis of hard information in credit evaluation, but for small, medium and micro enterprises, it is difficult to obtain enterprise financing only by the display of hard information. Chi Renyong et al. (2020) [5] found that the prediction ability of soft information is higher than that of hard information when using soft information and hard information to predict the credit risk of SMEs.

H2: The impact of unstructured soft information on credit evaluation of small, medium and micro high-tech enterprises is higher than that of hard information

2.3. Adjustment of the Scale of High-tech Enterprises

For large-scale high-tech enterprises, the financial system and articles of association will be relatively mature and perfect, and commercial banks and other lending institutions will be more inclined to choose large-scale high-tech enterprises, so hard information will have more obvious influence on the credit of large-scale high-tech enterprises. The following assumptions are therefore made:

H3a: Compared with large-scale high-tech enterprises, soft information has a more obvious impact on the credit of small, medium-sized and micro-high-tech enterprises.

H3b: Compared with small and medium-sized high-tech enterprises, hard information has more obvious impact on the credit of large-scale high-tech enterprises.

3. COLLECTION AND PROCESSING OF DATA

3.1. Sample Selection

First of all, according to the eight conditions and four indicators stipulated in the "Conditions and Measures for the Identification of High-tech Enterprises in National High-tech Industrial Development Zones", the high-tech enterprises in Anhui Province were identified. The relevant data of enterprises were taken from Guotai' an database and the official websites of various enterprises. Finally, 131 high-tech enterprises in Anhui Province were selected as valid samples. Secondly, the selected high-tech enterprises are classified according to the Statistical Classification Method for Large, Medium and Micro Enterprises (2017), among which the number of large-scale high-tech enterprises is 34.

3.2. Data Preprocessing

3.2.1. Screening samples and data processing

After pre-processing the screened data, 75 high-tech enterprises were found that the information ofcredit riskevaluation index was not published completely, and the missing values were filled in. When the variables were missing and the data missing was serious, the direct deletion method was adopted; when the data missing proportion was small, the median interpolation method was adopted.

3.2.2. Data reliability analysis

Prior to data analysis, reliability analysis was performed on some variables with missing data imputation to determine whether the imputed missing data had a significant impact on the model results. Cronbach's Alpha coefficient method is used to analyze reliability:

$$\alpha = \frac{k}{k-1}\left[1 - \frac{\sum_{i=1}^{k} S_i^2}{S_x^2}\right] \tag{1}$$

The mathematical software SPSS was used to calculate the partially missing data variables. The results are as follows:

Table1. Partial variable reliability coefficients for missing data

variables	GDP growth rate	Individual GDP	credit risk
Cronbach's Alpha	0.967	0.972	0.994

Alpha coefficients below 0.7 indicate that some variables need to be deleted. It can be seen from the above table that Cronbach's Alpha>0.7 belongs to high reliability, that is, missing data has no significant effect on the model results. Therefore, it does not affect the use of subsequent data.

4. STUDY DESIGN

4.1. Variable Is Set

This paper uses Chi Renyong et al. (2021) [6] for reference to set the following variables:

(1) Explanatory variables: This paper mainly measures the hard information of high-tech enterprises mainly through financial indicators (HARDINFOR), comprehensively calculates the comprehensive index of operating income growth rate and pre-tax profit growth rate of high-tech enterprises, and

reflects the soft information of high-tech enterprises from the aspects of reputation, entrepreneur's education degree, charity degree, trustworthiness, personnel flow, etc.

(2) Explanatory variable: enterprise credit. Credit risk comprehensively reflects the comprehensive score of high-tech enterprises evaluated by suppliers, customers and consumers through the credit line of commercial banks.

(3) Moderating variable: Choose enterprise size as moderating variable. If the enterprise is a large high-tech enterprise, the value is 1; if the enterprise is a small and medium-sized high-tech enterprise, the value is 0.

(4) Control variables: In addition to the above variables, this paper also sets up enterprise age, industry, GDP growth rate, personal GDP as control variables.

Table 2. Symbols and definitions of variables

variable name	the symbol	variable definition
explained variables		
enterprise credit	CREDIT	Comprehensive score of enterprise evaluation at supplier, customer and consumer
explanatory variables		
soft information	SOFTINFOR	Entrepreneur's interests, hobbies, social situation, etc. Comprehensive weighted score
hard information	HARDINFOR	Composite index of corporate revenue growth rate and pre-tax profit growth rate
control variable		
enterprise age	AGE	Time from establishment to survey date
industry	INDU	Dummy variable, 1 for industrial manufacturing, 0 for others
GDP growth rate	GROGDP	GDP growth/GDP of previous year
Individual GDP	PERGDP	GDP per capita, a measure of people's living standards
moderator variable		
enterprise scale	SIZE	Dummy variable: 0 for MSMEs and 1 for large enterprises

4.2. Model Setting

In this pape, OLS mixed regression model is used for hypothesis testing. In order to ensure the validity of the results, fixed effects model is further constructed in robustness test. For hypotheses H1 and H2, the basic model is set as:

$$CREDIT = a_1 + \alpha_1 SOFTINFOR + Controls + \varepsilon_1 \tag{2}$$

$$CREDIT = a_1 + \alpha_2 HARDINFOR + Controls + \varepsilon_2 \tag{3}$$

CREDIT is the credit level of high-tech enterprises, *SOFTWARE INFOR and HARDINFOR* are soft information and hard information indexes respectively, *Controls* is the set of control variables, ε is disturbance term, coefficientα is the key object studied in this paper. For H2, the sample is 97 small and medium-sized high-tech enterprises in Anhui Province.

For hypotheses H3a, H3b, the base model is set to:

$$CREDIT = b_1 + \gamma_1 SOFTINFOR \times M + \beta_1 M + Controls + \varepsilon_3 \tag{4}$$

$$CREDIT = b_2 + \gamma_2 HARDINFOR \times M + \beta_2 M + Controls + \varepsilon_4 \tag{5}$$

where M is the moderating variable (firm size), and γ is used todetermine whether there is a moderating effect.

5. EMPIRICAL ANALYSIS

5.1. Descriptive Statistics and Correlation Analysis

SPSS is used to process the sample data of 131 high-tech enterprises. Table 2 shows the descriptive statistics of various variables of enterprises.

Table 3. Descriptive statistics of variables

variable	minimum value	maximum value	average
AGEB usiness Age	0	34	6.75
INDU Industry	0	1	0.38
SIZEE nterprise size	0	1	0.26
SOFTWARE FORSOFT INFORMATION	1	5	3.2
HARDINFORHARD INFORMATION	1	6	4.46
CREDIT Corporate Credit	1	5	3.7
GROGDP GDP growth rate	0.05	0.09	0.07
PERGDP Personal GDP	10.06	10.85	10.34

Correlation coefficients for variables are shown in Table 3. The correlation coefficients among the variables in the table are not greater than 0.5, and the maximum expansion factor of each regression variance does not exceed 10, so it can be considered that there is no serious multicollinearity problem. The correlation coefficient between the credit risk of high-tech enterprises and the comprehensive index of hard information of enterprises is negative but not significant, while the correlation coefficient between the credit risk of high-tech enterprises and the comprehensive index of soft information of enterprises is negative and significant under p 0.01, which indicates that for small, medium and micro high-tech enterprises, the correlation between the credit risk of enterprises and the comprehensive index of soft information of enterprises is not strong, while the comprehensive index of soft information of enterprises is negative, which indicates that the higher the quality of soft information, the smaller the credit risk of enterprises.

Table 4. Correlation statistics of variables

	AGE	INDU	SIZE	SOFTINFOR	HARDINFOR	CREDIT	GROGDP	PERGDP
AGE	1							
INDU	0.424***	1						
SIZE	0.059	0.137***	1					
SOFTINFOR	-0.072*	0.100**	-0.066	1				
HARDINFOR	0.049	0.068	0.088*	0.442***	1			
CREDIT	0.148***	0.191***	0.017	-0.038***	-0.045	1		
GROGDP	-0.008	0.025	-0.070	0.165***	0.071	-0.082*	1	
PERGDP	0.082*	0.134***	0.002	-0.115**	-0.253***	0.05	0.177**	1

Note: *** represents p 0.01, ** represents p 0.05,* represents p 0.10.

5.2. Regression Analysis And Hypothesis Testing

5.2.1. The relationship between soft information and hard information and credit evaluation of high-tech enterprises

Model analysis based on hard information indicators: As shown in Table 5, the model regression results show that the comprehensive index of enterprise revenue growth rate and pre-tax profit growth rate has a significant positive impact on the credit risk of high-tech enterprises. The growth rate of income and profit before tax reflect the growth and net cash flow of the enterprise to some extent, thus reflecting the small business risk and low credit risk of the enterprise.

Model analysis based on soft information indicators: As shown in Table 5, the model regression results show that soft information indicators also have significant positive effects on the credit risk of high-tech enterprises. The enterprise is honest and trustworthy, actively assumes social responsibility, and has a good reputation among customers, suppliers and consumers, which also reflects the overall strength of the enterprise, competitiveness in the industry, low business risk and low credit risk. Therefore H1 is assumed to be verified.

Table 5. Regression results between soft and hard information indexes and credit level of high-tech enterprises

variable	Model (1)	Model (2)	Model (3)
AGE Business Age	0.003	0.003	0.003
	-0.003	-0.003	-0.003
INDU Industry	0.217***	0.218***	0.217***
	-0.034	-0.034	-0.034
SIZE Enterprise size	0.058	1.176***	-0.068
	-0.101	-0.366	-0.454
SOFTWARE FORSOFT INFORMATION	0.707***	0.705***	0.705***
	-0.032	-0.032	-0.035
HARDINFORHARD INFORMATION	0.165***	0.187***	0.165***
	-0.027	-0.027	-0.027
SIZE×SOFTINFOR		0.312***	
		-0.100	
SIZE×HARDINFOR			0.044
			-0.139
constant	0.499**	0.402*	0.509**
	-0.26	-0.206	-0.208
Pseudo-R^2	0.356	0.363	0.364

Note: *** represents p 0.01, ** represents p 0.05,* represents p 0.10.

5.2.2. Performance under different information mechanisms

Model analysis based on soft and hard information indicators: As shown in Table 5, soft information indicators are more important than hard information indicators when considering the impact of soft information indicators and hard information indicators on the credit risk of small, medium and micro high-tech enterprises. This paper thinks that the development of small and medium-sized high-tech enterprises is not mature enough, so it is difficult to present good hard information indicators to commercial banks and other lending institutions. Meanwhile, the soft information indicators of small and medium-sized high-tech enterprises in the growth period are more flexible and rich, so the importance is greater than hard information indicators. So the hypothesis H2 is verified.

5.2.3. Adjustment of the scale of high-tech enterprises

Enterprise size has a significant positive moderating effect between soft information index and enterprise credit risk. For small and medium-sized high-tech enterprises, the influence of soft information is greater than that of hard information, but for large high-tech enterprises, the influence of hard information is greater than that of soft information. This article thinks that because of the large-scale high-tech enterprises, enterprises have a long operating life, all aspects have been relatively mature and perfect, and their soft information is also relatively rich and perfect. Thus hypothesis H3a is verified, but hypothesis H3b is not.

5.3. Robustness Analysis

In order to ensure the robustness of the results, this paper carries out robustness tests from the following three aspects:

(1) The dynamic analysis model of lag phase is established. The results of lag phase further verify the hypothesis mentioned above.

(2) Before regression, 5% extreme values at both ends of variables were eliminated, and the results after discarding extreme values further verified the hypothesis. The empirical results of this paper are still valid.

(3) High-tech enterprises in industrial manufacturing industry are the representative type of high-tech enterprises. The regression analysis results of small samples further verify the above hypothesis, and the empirical results of this paper are still valid.

The robustness tests above do not change the original results, so we can consider that the empirical results of this paper have good robustness.

6. RESEARCH CONCLUSIONS AND DEVELOPMENT PROSPECTS

6.1. Research Conclusions

First, unstructured soft information index and structured hard information index both play an important role in credit risk assessment of high-tech enterprises, and have significant positive effects. At the same time, for small and medium-sized high-tech enterprises, soft information has more influence than hard information. Second, the smaller the scale of high-tech enterprises, the more obvious the influence of soft information on enterprise credit evaluation. For small and medium-sized high-tech enterprises, improving the role of soft information in credit risk evaluation can effectively help enterprises obtain financing. Third, commercial banks only rely on hard information index or soft information when evaluating the credit risk of high-tech enterprises, which will lead to distortion of enterprise credit risk evaluation and make enterprises with better credit unable to obtain financing.

6.2. Development Outlook

Improve the rating index system and credit rating supervision system of high-tech enterprises, pay attention to the application of soft and hard data, improve information data sharing, break information islands among enterprise credit rating departments, and eliminate technical obstacles, so as to improve the discrimination and accuracy of credit rating among high-tech enterprises.

Although soft information cannot be fully utilized and collected at this stage, with the development of big data technology, we can break the segmentation phenomenon between credit data departments by using big data technology, making data sharing and unstructured data collection possible, and restoring the credit ability of enterprises more comprehensively [7].

7. DEFICIENCY AND IMPROVEMENT OF MODEL

7.1. Model Deficiencies

7.1.1. Insufficient data selection

In the research process, the enterprises with missing data and conflicts are excluded, and the overall effective sample size is small, so the research results may have certain limitations.

7.1.2. Choice of Hard Information and Soft Information Index

Hard information is reflected throughthe composite index of operating income growth rate and pre-tax profit growth rate, but the relationship information of banks, that is, the depth of the relationship between banks and enterprises, has a substitute effect on the financial information of enterprises, and the research results may be affected. The soft information of the enterprise is reflectedbythe reputation of the enterprise, the education level of the entrepreneur, the charity degree, the trustworthiness situation, the personnel flow, etc., but the soft information cannot be quantified, and the collected data may have deviations.

7.2. Model Improvements

7.2.1. Data selection optimization

Further expand the sample search scope to cover enterprise data of prefecture-level cities in Anhui Province. For the problem caused by the lack of soft and hard information index data, the data can be estimated by prediction, and the sequence average method is adopted to calculate in the process to ensure the matching of corresponding data.

7.2.2. Optimization of soft information index

The collection cost of soft information is large and the discrimination cost is large. With the help of the powerful information collection and analysis processing ability of big data technology, we can make full use of its data advantages, cost advantages and efficiency advantages to dynamically adjust the collection of soft information and reduce errors.

8. COUNTERMEASURES AND SUGGESTIONS ON FINANCING OF HIGH-TECH ENTERPRISES

8.1. Demand Side: Expanding Domestic Demand

First, increase farmers 'income and promote farmers' consumption. On the one hand, we should continue to speed up the reform of the income distribution system, improve the social protection system, increase the disposable income of residents and expand the size of middle-income groups. On the other hand, we should start with internal circulation, reduce the difference between urban and rural per capita consumption expenditure level, and tap the structural potential of peasant household consumption. The second is to ease the financing constraints of small and micro enterprises and promote enterprise investment. First of all, government departments should establish a "white list" mechanism and formulate a directory of SMEs in the demand-side supply chain according to the credit rating of enterprises. Secondly, improve the government's laws, policies and regulations on financing of high-tech enterprises, and complete risk defense measures. The third is to allocate resources fairly and narrow the income gap. Further improve the digital unified management level of government enterprises, and fully optimize the allocation and regeneration of resources, so as to realize the high-quality development of the economic form of small and medium-sized technology enterprises in Anhui Province.

8.2. Supply Side: Deepen Supply-Side Reform

First, actively use big data and other technologies to build a new credit system and increase financing channels for high-tech enterprises. Create a multi-subject and multi-level financial market in the digital economy era to assist the development and upgrading of high-tech enterprises. Combining soft and hard information to enrich the credit risk rating of high-tech enterprises, adopt diversified and diversified financial instruments and service means to broaden their financing channels. Second, actively seek and stabilize international trade business with the help of new models and new technologies. Accelerate the formation of a distinctive, dynamic, market-oriented and professionally managed risk investment and financing system, give full play to the role of GEM, science and technology innovation board, small and medium-sized enterprise board, GEM and state-owned share transfer GEM, and dredge the operation and exit channels of GEM capital market.

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