

Application of Innovative Risk Early Warning Model Based on Big Data Technology in Internet Credit Financial Risk

Bingqiu Zhang, Business School, Suzhou University, China*

ABSTRACT

The emergence of the new economic model of internet credit industry brings convenience to people's lives, and it also impacts the business model of traditional commercial banking to a great extent. How to better improve the operation mode, correctly assess and avoid the risks of internet finance, and create a healthy, orderly, safe, and sustainable development environment of internet finance industry is an important research topic in this industry under the current situation. This paper studies the application of innovative risk early warning model based on big data technology in internet credit financial risk assessment, aiming at maximizing the utilization efficiency of internal and external data, building a timely, accurate, and effective early warning system with independent characteristics and creating a sharp weapon for intelligent risk early warning.

KEYWORDS

Big Data, Internet Credit Finance, Risk Assessment, Risk Warning

1. INTRODUCTION

In recent years, China's Internet information technology has developed rapidly and has been widely used in various industries, which has a certain impact on people's lives and daily production. With the rise of "Internet finance", the P2P peer-to-peer lending platform developed rapidly. In 2014, the turnover of China's P2P peer-to-peer lending industry was 252.8 billion yuan, far exceeding the turnover of the United States and Britain (Liu et al., 2017). As the pioneer of Internet finance, P2P peer-to-peer lending began to rise in China in 2007. After a short period of publicity and development, this new mode of micro-lending began to be accepted by the public with lightning speed, relying on its high income, low threshold and easy operation. It promotes the optimal allocation of funds, alleviates market information asymmetry and meets the needs of small and medium-sized enterprises for financing services (Liu et al., 2017). The credit system in the credit field is the core of the development of Internet finance, and it is also a major problem to be solved urgently. However, there are many challenges and problems in the development process, such as supervision, information security and risk control. How to correctly understand and solve the problems in the development process of Internet finance has become an important and urgent task.

With the advent of the era of big data, the financial sector is the key development area of the country. As the main position in the financial field, banks are affected by big data in risk management and control. To control financial risks, a sound financial early warning mechanism is needed as a

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*Corresponding Author

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guarantee (Lu, 2017, Zhao, 2018). Risk early warning needs standardized collection, modeling and analysis of multi-dimensional data information, deep integration of technology and business, system and experts, and continuous dynamic optimization according to external economic environment and regulatory requirements (Jiang et al., 2017). (Wang, 2016) thinks that the internet finance mentioned at present does not mean pure data finance or technology finance, nor does it mean that traditional financial institutions promote the convenience, efficiency and security of financial process by upgrading technology. (Gong et al., 2019) discussed the risk characteristics of electronic banking and the corresponding risk prevention measures by summarizing and applying fuzzy mathematics related evaluation methods; Its research shows that although the new model of e-banking overcomes various shortcomings and deficiencies of traditional banks. (Onyiriuba, 2016) put forward the method of credit risk quantification in his book, and put forward the importance of strengthening risk assessment in the process of commercial bank development. He put forward the credit risk existing in the business process of commercial banks through quantitative methods, and strengthened the strategy of risk management. (Reint et al., 2019) proposed that the government should play a leading role in strengthening and spreading the positive externalities of network finance and even the whole financial industry, and weakening the negative externalities of network finance.

Nowadays, data has penetrated into every industry and business field and become an important production factor. The newly generated data in the world will increase by 40% every year, and the total amount of global information will double every two years (Chen et al., 2017). With the rapid development of information technology, judging and identifying financial risks by combining the collected historical data, mathematical indicators, statistical models, data mining and other models and algorithms has become a research hotspot of financial risk early warning mechanism. By analyzing big data and establishing an early warning system for bad credit risk of banks, the problem of information asymmetry between banks and customers can be solved, thus improving the risk control ability and management level of banks. On the basis of absorbing and digesting the research and practice achievements of existing Internet credit and financial risk early warning system at home and abroad, and combining with Internet finance and financial informationization, big data analysis theory and technology, a real and effective Internet credit and financial risk early warning system with financial big data as the core is constructed, so as to scientifically diagnose and identify Internet credit and financial risks. This paper studies the application of innovation risk early warning model based on big data technology in Internet credit and financial risk assessment, aiming to maximize the utilization efficiency of internal and external data, build a timely, accurate, effective and independent early warning system, and create a sharp weapon for intelligent risk early warning. Thereby promoting the healthy and benign development of China's Internet finance industry.

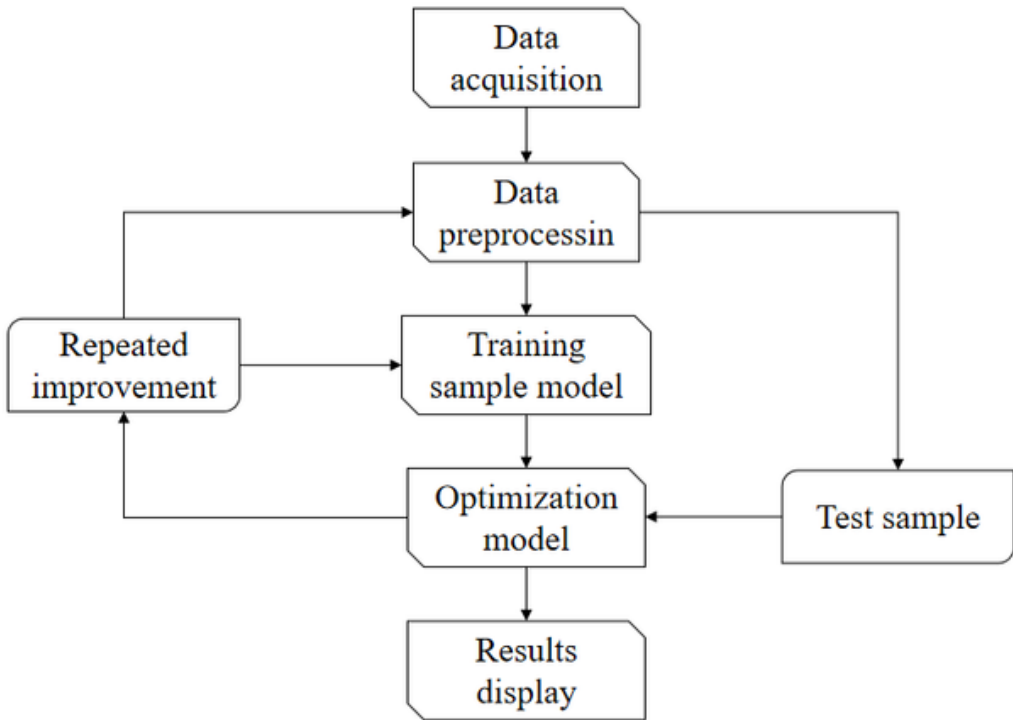
2. METHODOLOGY

In the design of early warning system for bad bank credit under big data, it is necessary to deal with the inaccurate data in massive data and establish the corresponding data relation algorithm, so as to optimize the problem of bad bank credit risk. Internet financial platform is not only the medium of Internet transactions, but also the role of transmitting information and publicizing financial services. Different from traditional finance, Internet financial platform can't perceive customers' feelings and discover abnormal behaviors through face-to-face conversation (Du et al., 2016, Pang, 2018). Credit rating is not only to examine the value of the enterprise itself or to produce performance, but also to focus on human factors, that is, the appraisee's willingness to fulfill commitments or take risks. The macro-prudential indicators mainly include economic growth, inflation and interest rate, while the comprehensive micro-prudential indicators include capital adequacy ratio, profitability index and asset quality index. The basic way of solving problems is simulated as an "input-output" system, and the "weight" of input information is described by hidden layer. By adjusting the weight of input information, the expected output results are finally obtained. Avoid the redundancy of the underlying

data, and build a big data platform at the whole bank level, and transform the scattered internal and external data information into an organically related unity through extensive mapping relationships.

In this paper, based on Spark distributed computing platform (Zhou et al., 2019), a variety of models are selected by machine learning method to train the training sample set, and its accuracy is tested by testing the sample set. By repeatedly adjusting and preprocessing the original data field, the optimal early warning model of network credit and financial risks is obtained (Figure 1). In the process of modeling, the selection of feature fields, the selection of models and the interpretation of conclusions will be the focus of this part.

Figure 1. Model building process



Candidate words are not completely independent, and there are prefix-based inclusion relations, such as “risk assessment summary table” and “risk assessment”, or cross ambiguity. It is necessary to calculate the segmentation probability of each combination according to candidate words in various fields, and take the combination with the highest probability as the best text segmentation method. The expression of segmentation probability is (Acharya et al., 2018):

$$p(w | s) = \frac{p(w)p(s | w)}{p(s)} \quad (1)$$

w is the combination of segmentation, s is the text to be segmented, and $p(w | s)$ represents the probability that the text s is segmented in w mode. Because the text s is unchanged, the value of $p(s)$ is unchanged and the value of $p(s | w)$ is 1, so the maximum segmentation probability

$\arg \max_w p(w | s)$ can be obtained by comparing the sizes of $p(w)$. Assuming that there are n kinds of segmentation combinations, in which the i th segmentation combination has m words, the probability of this combination can be expressed as:

$$p(w_i^n) = \prod_{1}^m p(w_m) \quad (2)$$

Because the probability of domain words is low in actual situation, the product operation will lead to too small values, so we can carry out logarithmic processing on formula (2) to get formula (3) and formula (4):

$$\log p(w_i^n) = \sum_{1}^m \log p(w_m) \quad (3)$$

$$p(w_m) = \frac{C(w_m) + 1}{N + V} \quad (4)$$

In which N is the total frequency of all domain words in the dictionary, V is the number of domain words, $C(w_m)$ is the number of w_m , and the value is 0 when w_m is not in the dictionary. The processing mode of formula (4) can solve the situation that the frequency of new words is 0.

Compared with the traditional risk management mode and early warning and monitoring means of commercial banks, the information-based risk early warning system based on big data technology is more diversified in data acquisition, deeper in information mining, more comprehensive in function design and more accurate in early warning and monitoring (Lu, 2017).

Personal credit risk assessment is to find out the key indicators that can affect the future performance of customers. However, this information is characterized by a large number of fuzzy, random and incomplete information, which requires deep mining and quantification of data to obtain hidden information. In reality, the Internet financial industry has not yet formed a unified and standardized operation process, and the industry associations are still in a weak position, lacking the authority to form and promote industry norms, which makes the business processes provided by Internet financial service providers inevitably differ. On the basis of identifying risks, the probability, possibility and influence of each risk are evaluated to a certain extent, and then the risk level is evaluated as a whole. Build an early warning signal system with independent characteristics, covering early warning topics such as credit behavior, operation and management, financial status, account status, group status, and related individuals of credit customers. Infiltrate every link of Internet credit and financial activities, and even based on financial virtuality and credit, we must consider the trend of public opinion. Overall consideration of national and regional macroeconomic operation, economic and social development and industry development, etc.

See formula (5)(Zhong et al., 2018) for the definition of Kulc measurement evaluation. this measurement formula can be regarded as the average of two conditional probabilities, and the result of the formula is only related to A , B and $A \cup B$, so as to avoid the influence of total risks and the number of safety inspection activities. The measurement result interval is $[0,1]$, and the greater the measurement result, the closer the relationship between risk A and risk B .

$$Kulc(A, B) = \frac{1}{2}(P(A | B) + P(B | A)) \quad (5)$$

Imbalance Ratio(IR) is defined in formula (6), which reflects the unbalance degree of two risks. The closer the frequency is, the smaller the unbalance ratio is, and when the frequency is equal, the unbalance ratio is zero.

$$IR(A, B) = \frac{|Sup(A) - Sup(B)|}{Sup(A) + Sup(B) - Sup(A \cup B)} \quad (6)$$

Assume that A and B are two risks, AB is the frequency of two risks appearing at the same time, $A\bar{B}$ indicates the frequency of A but B does not exist, and $\bar{A}B$ indicates the frequency of B but A does not exist. Calculate the values of confidence, $Kulc$ and IR in four scenarios respectively, and get Table 1.

Table 1. Measure value of redundant risk information in different situations

	$.AB.$	$A\bar{B}$	$\bar{A}B$	$Conf(A \Rightarrow B)$	$Conf(B \Rightarrow A)$	$Kulc$	IR
Scenario 1	100	10	100	0.93	0.93	0.93	0.00
Scenario 2	10	100	100	0.08	0.08	0.08	0.01
Scenario 3	100	50	200	0.66	0.34	0.56	0.00
Scenario 4	10	0	100	1.00	0.08	0.47	0.85

There are two data utilization modes of credit risk rating, one is closed data mode, which is similar to Ali Credit. Closed data system mainly carries out credit rating and risk control through the company's own transaction and payment data. The other is data sharing system, which means that a large number of smaller companies share data with an intermediary agency, and the intermediary agency serves as the medium to share data. Through in-depth exploration of machine learning, machine learning algorithm is combined with customer behavior, behavior model is constructed, risk perception ability is improved, known and unknown fraud behaviors are detected, and intelligent risk monitoring is realized (Bao, 2016). According to the risk situation, alarm in different degrees will be sent to corresponding posts to take measures, and risk control measures will be taken in advance, so as to avoid the adverse impact of further expansion of risks on commercial banks. Identifying and discovering potential risks in Internet finance from big data requires the ability to deal with the scale, diversity and high speed of big data. To deal with the big data problem in Internet finance, it is necessary to establish a complete and scientific early warning system for Internet financial risks. Under the influence of big data, banks' non-performing loans are informative and redundant, which leads to weak early warning ability of banks' non-performing loans. By establishing an early warning system, banks can effectively solve credit management problems.

3. RESULT ANALYSIS AND DISCUSSION

After the above indicators are constructed and the weights are calculated, it is necessary to choose an appropriate method to evaluate the Internet financial risks, and to carry out a series of data

preprocessing such as missing value repair and abnormal value detection, so as to standardize the original data format and meet the requirements of the training model. Generally speaking, the premise that different participants decide to use the Internet to conduct financial transactions is that they hold an attitude of recognition to the financial platform provided by the Internet and its credibility. The borrower's age, sex, industry, loan period and loan purpose have only a slight influence on its default rate. And commercial banks can effectively avoid the risk of exchange rate through currency swap or currency forward contract (Xu, 2017). Inflation risk mainly refers to that the credit assets of commercial banks are affected by inflation and other factors, which makes the objective actual value relatively reduced. Through automatic keyword extraction and manual judgment, keywords that can distinguish different topics are selected, and then corresponding retrieval expressions are formulated by using these keywords, so as to realize automatic classification retrieval of relevant information. Thus, the data can be obtained, and the error ratio between the traditional algorithm and the improved algorithm can be obtained by comparing with the bank data report.

Under the Internet financial model, commercial banks should not only cope with the competition for customers by the Internet financial model, but also deal with the risks brought by the Internet model to banks (Zhao et al., 2018). Different Internet financial models bring different risks, which leads to the weakening of payment and settlement status of commercial banks and the impact on traditional businesses. Based on the above analysis, the strengths, weaknesses, opportunities and threats of commercial banks under the Internet financial model are shown in Table 2.

Table 2. Swot analysis of banks under the internet financial model

Advantage	Inferiority
(1) abundant offline payment terminals; (2) Strong financial professional payment ability; (3) Strong credibility and capital strength	(1) The trading platform is complex; (2) higher transaction costs; (3) The mode of operation and management is more traditional.
Opportunity	Threaten
Enhance industry competitiveness	The status of payment and settlement is weakened and the business is impacted

Because a large part of these risks are difficult to measure, it is difficult to transform and obtain data when selecting evaluation indicators. For example, reputation risk, which has a long-term impact, may not be quantified by banks. Therefore, this kind of risk is qualitative risk, which can be comprehensively scored by experts to determine the size of the risk. Table 3 shows the risk system faced by banks under the Internet financial model.

Table 3. The risk system faced by banks under the Internet financial model

Types of internet finance	Risk type
P2P financing risks(A_1)	Reputation risk(B_1)
	Regulatory risk (B_2)
	Pass on risk(B_3)

Table 3 continued on next page

Table 3 continued

Types of internet finance	Risk type
E-commerce credit risk(A_2)	Risk of loss of credit business (B_4)
	Credit card cashing risk (B_5)
Financial risks(A_3)	Risk of loss of deposits and wealth management funds(B_6)
	Pricing risk(B_7)
Third-party payment risks(A_4)	Transaction cost risk(B_8)
	Legal risk(B_9)

Judgment matrix is the first step of the whole analytic hierarchy process, and it is also the key step that affects the weight of each index. By comparing the importance of every two indicators at the same level, the matrix that can represent the importance result is obtained. In order to make the results as fair as possible, 8 staff members of a local bank were invited to a professor in the field of school finance, and a total of 9 people scored the importance of indicators, and then took the geometric mean value to construct a judgment matrix. The main basis in the process of importance scoring is shown in Table 4, and different numbers represent the same degree of importance.

Table 4. Scale and meaning of judgment matrix

Scale	Explain the comparison between the two factors
1	Factor i is as important as factor j .
3	Factor i is more important than factor j .
5	Factor i is more important than factor j .
7	Factor i is much more important than factor j .
9	Factor i is more important than factor j .
2,4,6,8	Importance between the above scales
Fraction	The comparison between factor i and factor j is judged as a_{ij} , and the comparison between factor j and factor i is judged as $a_{ji} = 1 / a_{ij}$

Taking the first-level judgment matrix as an example, the geometric mean of the scores of nine experts is taken. The first-level judgment matrix is as follows

$$D = \begin{bmatrix} 1 & 0.3 & 0.25 & 0.33 \\ 4 & 2 & 0.6 & 2 \\ 2 & 1 & 1 & 2 \\ 5 & 0.3 & 0.33 & 6 \end{bmatrix} \quad (7)$$

The matrix is normalized and then tested for consistency
Consistency test formula:

$$CI = \frac{\lambda_{\max} - n}{n - 1}, CR = \frac{CI}{RI} \quad (8)$$

$CI = 0.005$ after calculation. according to Table 5, the average random consistency index of RI is found to be 0.87. Therefore, CR is 0.006

Table 5. RI standard value

N	1	2	3	4	5	6	7	8	9
RI	0	0	0.56	0.87	1.12	0.24	1.34	1.39	1.17

Therefore $CR = 0.006 < 0.1$, it can be considered that the judgment matrix meets the consistency test, that is to say, the calculated weights are reliable and the weight values pass the test.

According to the above hierarchy judgment method, the index weights of risks at all levels are calculated, as shown in Table 6:

Table 6. Risk indicator system under bank internet finance model

Types of internet finance	Weight	Risk type	Relative weight	Comprehensive weight
P2P financing risks(A_1)	0.034	Reputation risk(B_1)	0.201	0.021
		Regulatory risk (B_2)	0.547	0.114
		Pass on risk(B_3)	0.106	0.026
E-commerce credit risk(A_2)	0.332	Risk of loss of credit business (B_4)	0.665	0.133
		Credit card cashing risk (B_5)	0.124	0.052

Table 6 continued on next page

Table 6 continued

Types of internet finance	Weight	Risk type	Relative weight	Comprehensive weight
Financial risks(A_3)	0.405	Risk of loss of deposits and wealth management funds(B_6)	0.823	0.210
		Pricing risk(B_7)	0.205	0.068
Third-party payment risks(A_4)	0.107	Transaction cost risk(B_8)	0.332	0.084
		Legal risk(B_9)	0.521	0.0664

It can be seen from the above table 5 that under the internet financial model, the biggest impact on banks is financial management risks, accounting for 40.5%, followed by e-commerce credit risks, accounting for 33.2%, and third-party payment risks, accounting for 10.7%. P2P financing risks account for only 3.4%. Among the secondary risk indicators, comprehensively, the greatest impact is the risk of loss of deposits and wealth management funds, accounting for 21.0%, followed by the risk of loss of credit business, accounting for 13.3%, and the third is regulatory risk, accounting for 11.4%, which accounts for 45.7% of the total risk. Banks should pay attention to the risks under the Internet mode, which have great influence on these risks.

In the credit risk management of commercial banks, the risks caused by operational risks mainly refer to the adverse effects on lenders caused by internal control during the operation of commercial banks. Due to the characteristics of the online trading environment, once users find that there are financial losses or behaviors such as bullying and fraud in the process of Internet financial service transactions, it will inevitably lead to a series of legal liability issues such as the validity of online contracts, online dispute litigation, and the responsibility of online transactions and the identification of electronic evidence. Its ultimate goal is to find out the advantages and disadvantages of risk assessment, especially to find out the shortcomings and take targeted measures to solve the existing problems, so as to promote the development of the assessment object in a better direction. The early warning system needs to establish a sound system for data management so as to export, arrange, analyze, process and store the data. It is necessary to improve the data management mechanism for Internet credit and financial supervision, and establish a data center that matches the regional economic and financial development. Mining multiple customer associations to form a visual map, so as to realize the inquiry of customer associations under complex paths and effectively identify the transmission risks of hidden associations.

This paper will use 10 indicators to judge the credit risk of borrowers, including gender, marital status, age, educational background, loan period, loan amount, occupation, property status, repayment willingness and guarantee status of relatives and friends. Sample data are collected and standardized, and the standardized sample data are input into the risk early warning model. When the training error reaches the pre-designed error precision, the output result is output, and the final conclusion of the borrower's risk assessment is made according to the output result and the evaluation set. After training and fitting, the prediction results of the risk early warning model generated by training are verified (Table 7).

Table 7. Test result

Grade	Number of test samples	Number of errors	Accuracy (%)
Excellent	30	0	100
Good	20	1	95
General	15	0	100
Poor	25	0	100
Breach of contract	25	1	96

It can be seen from the evaluation of the credit risk level of the para-borrower by the risk early warning model that in this training, only a few evaluation mistakes have occurred, and the rest have reached the prediction standard. The output result predicted by the model is basically consistent with the target output result.

Internet financial risk early warning system is a large system for monitoring, forecasting and early warning of Internet financial risks, which must cover the whole process of Internet financial activities. The results of early warning can also be verified with the information judged by experts. Combined early warning realizes the connection and integration of information fragments that have been isolated from each other, such as public and retail risk information, accounting and business management information, internal and external information, and discovers the relationship and rules among them. In this way, the collection, classification, matching and processing of credit data will become easy. At the same time, a unified credit data query system is formed (Khan, 2020). Meanwhile, under the premise of ensuring the normal operation of the financial system, the early warning system is constantly updated, improved and perfected with the passage of time and social and economic changes, so as to ensure that different modules with different functions of the early warning system operate independently, thus improving the stability and reliability of the system. It reduces the calculation error of the bank's bad credit early warning system, greatly improves the bank's bad credit early warning ability, and further improves the bank's credit management ability.

4. CONCLUSION

Internet finance is booming in China, its operation mode is innovative and changeable, and risks are also around it, as a combination of Internet and finance industries. On the one hand, Internet enterprises should constantly reduce their own risks caused by the characteristics of the Internet, and at the same time pay attention to the research and technology research and development of network technology risks. On the other hand, it is necessary for the financial industry to design more rigorous and standardized service and transaction processes, so as to effectively reduce risks. Through internal flow settlement data, external credit behavior data, government rewards and punishments and other public credit information data, the system can introduce the personal credit status and important litigation-related information of the actual controller of the enterprise at the same time, so as to achieve the purpose of comprehensive evaluation of customer risk quality; When the internal and external environment of Internet credit finance changes, resulting in abnormal operation of Internet credit finance, the system will send out early warning information in time to provide decision support for preventing and defusing the risks of Internet credit finance, so as to ensure the effective operation of regional economy.

Internet contains a wide range of contents and rich models. This article does not take into account the possible risks in all areas of Internet finance from a higher and larger perspective, which is incomplete.

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Zhang Bingqiu is an Associate Professor of the Suzhou University, China. She received her master's degree in law from the Anhui University and a master's degree in economics from the Anhui University of Finance and Economics, China. Her current research interests are financial technology, private capital investment and financing, rural economy.