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Research on Credit Risk of P2P Network Loan Platform

Based on CRITIC-GRA Model

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***Abstract*—Against the background that Chinese economy is in the critical period of transformation, P2P online loan is undergoing a period of integration from the standardized operation to the mature stage. The defects of management system and supervision system lead to the high credit risk of P2P online loan platform. In this paper, considering the operation status, capital strength, liquidity and credit risk of the borrower of the platform, the CRITIC-GRA comprehensive evaluation model is used to establish the evaluation system of the platform credit risk. Meanwhile, using the data of 50 online loan platforms in China as samples for empirical analysis, this paper sorts the credit risk of 50 online loan platforms, and puts forward constructive suggestions and countermeasures.**

Keywords: P2P online loan platform, CRITIC-GRA model, credit risk

I. INTRODUCTION

Nowadays P2P online loan has become one of the main forms of Internet finance. P2P online loan platform integrates P2P technology and private lending, and uses the Internet to focus the scattered private lending in the past on one platform, playing the role of financial intermediary. The platform connects the lender on one side and the borrower on the other, so as to realize the point-to-point connection between the lender and the borrower. This lending model first appeared in Chinese financial market when "ppdai" was established in Shanghai in 2007. Due to the impact of "thunderstorm wave" and "liquidation wave", some platforms were forced to withdraw from the platform in a benign way, some platforms collapsed due to their poor management, and some platforms had credit risks such as loss of contact and payment difficulties. In the first three quarters of 2019, the number of online loan platforms in normal operation in China decreased by 795, leaving only 807 in September 2019.

The risks of P2P online loan mainly include policy risk, emerging market risk, borrower default risk and platform credit risk. This paper explores the credit risk evaluation system of Chinese P2P online loan platform, and puts forward targeted suggestions based on empirical test.

II. LITERATURE REVIEW

P2P online loan is faced with both opportunities and challenges. On the one hand, the new financial model derived from financial technology represented by P2P can overcome some disadvantages of traditional finance, such as high transaction cost, low efficiency, information asymmetry and fraud risk. On the other hand, the infrastructure of fintech is still not perfect, the boundary of innovation is blurred, and data privacy concerns and so on make P2P also face challenges.

Therefore, how to effectively control the risk has become the primary task for managers. At present, the research on the risk of P2P online loan platform by domestic scholars mainly includes two aspects:

First, it comprehensively discusses the various risks existing in the operation process. Yang et al. (2014) believe that the risks of P2P online loan platforms include lack of legal supervision, credit card cash and money laundering risk, borrower default risk, liquidity risk and capital strength and management risk. Ye (2014) proposed that when engaged in the online loan guarantee business, if a small loan company breaks through the high-voltage line of leverage ratio, it will bring greater operational risks to the online loan platform. Zhang (2018) used factor analysis to determine the four factors of operating capacity, capital liquidity, platform operating risk and capital concentration of the credit platform, which had an important impact on the risk assessment of P2P online loan platform.

Second, it focuses on analyzing the credit risk. The empirical analysis by Xiao et al. (2015) showed that personal characteristics, credit variables, historical performance and borrowing information have a great impact on platform credit risk. Wang et al. (2016) used AHP to build quantitative index evaluation system and qualitative index evaluation model from four dimensions of platform operation data, basic information, and information disclosure and platform credit enhancement.

III. CREDIT RISK EVALUATION BASED ON CRITIC-GRA MODEL

From 1,602 operating platforms in December 2018 to 807 operating platforms in September 2019, the number of normal operating platforms decreased by 795 in nine months, but there was basically no new online loan platform in the same period. Based on the explosion of P2P industry in 2018, it can be seen that due to its rapid development and relatively lagging regulation, private P2P is in a capital operation dilemma. Driven by the compliance of financial regulators, domestic P2P online loan platforms begin to expose their own risks such as non-standard information disclosure, suspension of business and "road running".

In this paper, 50 P2P online loan platforms are selected as empirical samples according to the transaction scale, operation status and other conditions, and the official website of "www.p2peye.com" is taken as the data source, so as to build an evaluation model of credit risk influencing factors of online loan platforms and carry out empirical analysis.

A. Index selection

Given that the P2P online loan is actually the extension of traditional financial industry based on the Internet, the traditional financial industry has a certain commonality. Therefore, this article refer to traditional risk rating system of financial industry and the western commercial banks "5C" principle, from the platform's operating conditions, capital strength, liquidity, and the borrower's credit risk into four aspects, choose change rate of transaction volume on a sequential basis, interest rate, average borrowing term, number of borrowers, registered capital and rate of overdue amount six indicators, the influence factors of the P2P online loan platform credit risk evaluation.

Among them, the operating status of the platform is measured by the change rate of transaction volume on a sequential basis, the interest rate and the number of borrowers, the liquidity of funds is measured by the average borrowing term, the credit risk of borrowers is measured by the rate of overdue amount, and the registered capital is measured by the capital strength of the platform or reflects the credibility of the platform.

The specific meanings of the six indicators are as follows.

1) Change rate of transaction volume on a sequential basis (X_1): This index reflects the speed of operation of P2P online loan platforms. Because Chinese P2P online loan is in a compliance transition period, there are still loopholes in the supervision and management system and insufficient risk control capacity. Therefore, when this index of the online loan platform changes too much, the internal control operation of the platform is likely to be chaotic, which greatly increases the credit risk of the platform.

2) Interest rate (X_2): This index refers to the average nominal interest rate of various platform products, and is the market performance of the deal matching between wealth manager and borrower. The higher the nominal interest rate, the higher the probability that the borrower's real capital cost is high, and the higher the possibility of default risk.

3) *Average borrowing term (X_3):* This index refers to the time from the date when the online loan platform transfers the full amount of the bidding funds to the borrower until the date when the borrower agrees to the end of repayment. To a certain extent, its size can reflect the liquidity of online loan platform funds. The longer the loan term is, the more favorable it is for the capital turnover of the platform, but the greater the uncertainty of the borrower is, the greater the risk of default. Therefore, the average borrowing term increases, the liquidity of the platform decreases and the credit risk intensifies.

4) *Number of borrowers (X_4):* This index can reflect the operation status of the platform. The more borrowers there are, the more the asset end of the online loan platform will conform to the characteristics of small amount diversification. According to the characteristics of the industry, in the case of the same amount of loans, if the corresponding number of borrowers is larger, the per capita amount of loans will be smaller, thus the borrower's possible default amount will be smaller and the credit risk will be reduced.

5) *Registered capital (X_5):* This index refers to the total amount of investment that P2P online loan platform companies have paid or promised to pay. The more registered capital the platform has, the stronger its capital strength will be. Therefore, the higher the registered capital of the platform, the lower its credit risk will be.

6) *Rate of overdue amount (X_6):* This indicator reflects the ratio of the borrower's failure to repay the loan principal and interest on schedule to the total loan fund in accordance with the loan contract. The high rate of overdue amount indicates that the platform fails to take effective measures to prevent the borrower's credit risk, and the credit risk will increase.

B. Data processing

Among the six indicators selected in this paper, X_1, X_2, X_3 and X_6 are positive indicators, while X_4 and X_5 are reverse indicators. The positive indicators and negative indicators were standardized by using the following formulas (3-1) and (3-2).

$$d_{ij} = \frac{f_{ij} - \min\limits_i f_{ij}}{\max\limits_i f_{ij} - \min\limits_i f_{ij}} \quad (3\text{-}1)$$

$$d_{ij} = \frac{\max\limits_i f_{ij} - f_{ij}}{\max\limits_i f_{ij} - \min\limits_i f_{ij}} \quad (3\text{-}2)$$

Where, f_{ij} refers to the index j of the ith P2P lending platform, $i = 1,2,\cdots,50; j = 1,2,3,4,5,6$.

C. CRITIC weighting method

This paper uses the multi-index comprehensive evaluation system to compare and analyze the influencing factors of credit risk of P2P online loan platforms. Multi-index comprehensive evaluation can solve the problem of ranking the priority decision-making schemes under multiple indexes. The key point is how to determine reasonable weights for each index. Based on the objectivity, this paper selects the CRITIC weighting method.

The basic idea of CRITIC method is to determine the objective weight of each index based on the two basic variables of contrast intensity and conflict between indexes. The contrast intensity refers to the difference of evaluation scheme values of the same index. It is represented by standard deviation, that is, the larger the standard deviation of the σ_j, the greater the value difference of each scheme of the jth index. The conflict between the indexes is calculated based on the correlation between the indexes. The conflict between the jth index and other indexes is quantified as:

$$T_j = \sum_{i=1}^{50}(1 - r_{ij}) \tag{3-3}$$

Where, r_{ij} is the correlation coefficient of the evaluation index i and j.

The objective weight is calculated by the contrast intensity and the conflict between indexes. Therefore, the objective weight of the jth index is W_j:

$$W_j = \frac{\sigma_j T_j}{\sum_{j=1}^{6}(\sigma_j T_j)}; j = 1,2,\cdots,6 \tag{3-4}$$

D. The GRA model based on the CRITIC method

Gray Relation Analysis (GRA) is a method of situation analysis based on the similarity and proximity of each index sequence curve. If the change trend of the two indexes is consistent, the degree of synchronous change is high, and the degree of relation between the two indexes is considered high. On the contrary, the relation between the two is relatively small. GRA can overcome the limitation of traditional probabilistic statistics requiring large samples, so this paper establishes the CRITIC-GRA model. The specific steps are as follows:

1) Determining the sample sequence: Let the reference sequence be $X_0 = \{X_0(k)|k = 1,2,\cdots,n\}$ and the comparison sequence be $X_i = \{X_i(k)|k = 1,2,\cdots,n\}, i = 1,2,\cdots,m$. The comparison sequence is a matrix composed of six index data from 50 P2P online loan platforms, and the reference sequence is the optimal value of data based on index attributes. Therefore, the reference sequence can effectively reflect the comparative relationship between each evaluation index data.

2) Standardization of sample data: In order to avoid the influence of dimensional problems on the correct conclusion, formulas (3-1) and (3-2) are still used here to standardize the original data sequence.

3) Determining the weight of indicators: This paper determines the weights of six evaluation indicators by the method of CRITIC assignment introduced in section 3.3.

4) Calculating the absolute sequence difference: The absolute difference between each point on the X_0-curve of the comparison sequence and each point on the X_i-curve of the reference sequence is recorded as $\Delta_{0i}(k)$. That is:

$$\Delta_{0i}(k) = |X_0(k) - X_i(k)|; i = 1,2,\cdots,m; k = 1,2,\cdots,n$$

5) Calculating the relation coefficient: The specific calculation formula of grey relation coefficient $\xi_i(k)$ is as follows:

$$\xi_i(k) = \frac{\Delta_{min} + \rho\Delta_{max}}{\Delta_{0i}(k) + \rho\Delta_{max}}; i = 1,2,\cdots,m; k = 1,2,\cdots,n$$

Where, ρ is the discrimination coefficient, which reflects the degree of indirect influence of each factor of the system on the relation degree. Generally, when $\rho \le 0.5463$, the resolution is strong. In this paper, $\rho = 0.5$.

6) Calculating and sorting the grey relation degree: The specific calculation formula of the comprehensive relation degree is:

$$r_i = \sum_{k=1}^{n} \omega_k \cdot \xi_i(k); i = 1,2,\cdots,m$$

IV. EMPIRICAL RESULTS AND ANALYSIS

A. Empirical results

In this paper, the correlation coefficients of six indexes obtained from the standardized sample data analysis of 50 P2P online loan platforms are shown in "Table I" below:

TABLE I. INDEX CORRELATION COEFFICIENT

	X_1	X_2	X_3	X_4	X_5	X_6
X_1	1	0.015385416	0.13596715	0.015967709	0.051507943	0.201315068
X_2	0.015385416	1	0.461326362	0.210430818	0.037256248	0.088779855
X_3	0.13596715	0.461326362	1	0.12599877	0.000166791	0.218316762
X_4	0.015967709	0.210430818	0.12599877	1	0.243307115	0.129721771
X_5	0.051507943	0.037256248	0.000166791	0.243307115	1	0.047634093
X_6	0.201315068	0.088779855	0.218316762	0.129721771	0.047634093	1

The contrast intensity σ, the conflict between the indexes T and the objective weight W of each index are as follows ("Table II").

TABLE II. CONTRAST INTENSITY, CONFLICT, OBJECTIVE WEIGHT1

	X_1	X_2	X_3	X_4	X_5	X_6
σ	0.1420	0.1968	0.3232	0.2138	0.1787	0.3177
T	5.2544	4.6077	4.5822	5.2069	4.6201	4.9763
W	0.1121	0.1363	0.2226	0.1673	0.1241	0.2376

According to the GRA model in 3.4, the credit risk of 50 P2P online loan platforms is ranked from small to large. Some platforms' data are as follows ("Table III"):

TABLE III. CREDIT RISK RANKING OF P2P PLATFORMS2

P2P Platform Name	Correlation Degree	Ranking
Bojin Loan	0.492207	1
Zhangzhong Wealth	0.501145	2
Smiling Face Finance	0.502454	3
Hairongyi	0.510455	4
Caimitech	0.515692	5
Jintouxing	0.51658	6
Yangqianguan	0.517311	7
Newup	0.518477	8
Eloancn	0.525178	9
Xiaoniu88	0.530898	10

B. Analysis and comparison of results

1) Importance analysis of credit risk influencing factors: According to the results in "Table III", the weight values of influencing factors obtained according to CRITIC method are sorted as follows: rate of overdue amount, average borrowing term, number of borrowers, interest rate, registered capital, change rate of transaction volume on a sequential basis.

The weight of the rate of overdue amount is the largest, indicating that the credit degree of the borrower has the greatest impact on the risk assessment of online loan platform. In P2P online loan, borrowers can make full use of their favorable position in online transactions to benefit themselves and make investors suffer. According to the principle of information asymmetry, the borrower has the problem of moral hazard or adverse selection.

The weight of the average borrowing term ranked second among the six indicators that measure the credit risk of online loan platforms. The longer the average borrowing term of online loan is, the higher the liquidity risk premium required by investors is, and the greater the borrower's probability of default. However, this index is also influenced by the quality and duration of investment projects. If the platform matches the funds in a reasonable duration, the risk of default can be reduced. Therefore, the role of this indicator is relatively weaker than the rate of overdue amount.

The number of borrowers, the interest rate and the change rate of transaction volume on a sequential basis reflect the operating capacity of the online loan platform, which is relatively insignificant. The number of borrowers measures the liquidity of operating funds of the online lending platform, the interest rate measures the possibility of profit of the platform, and the change rate of transaction volume on a sequential basis measures the development speed of the platform. Due to the obvious "herd effect" in Chinese microfinance market, even if the three indicators tend to change in a favorable way, if the operation and management of online loan platforms are improper and the internal control operation is chaotic, the credit risks of P2P online loan platforms will increase greatly. Therefore, the above three indicators have less influence on the platform credit risk alone.

The small weight of the registered capital is due to the fluctuation of P2P online loan market in recent years, and most companies with weak capital stagnated operation, so the remaining online loan platforms are all companies with high registered capital. In the sample of 50 P2P online lending platforms, the registered capital of 9fpuhui is up to 2 billion yuan, and the minimum wealth of Zhangzhong Wealth is 10 million yuan, while most of the platforms are 50 to 100 million yuan, reaching the high threshold for traditional financial institutions. Therefore, with the withdrawal of online loan platforms with low registered

capital, the possibility of credit risk caused by them is greatly reduced.

2) Credit risks of P2P online loan platforms: According to the CRITIC-GRA model and the sample data of selected indicators, the comprehensive correlation degree of 50 P2P online loan platforms in China is shown in table 4.3.The higher the grey correlation, the greater the credit risk of the platform. Conversely, the credit risk is smaller.

The analysis results in table 4.3 show that the average grey correlation degree of credit risk of P2P online loan platforms is 0.593591, and among the 50 sample companies, the proportion of the comprehensive correlation degree lower than the mean is 42%. Generally speaking, the credit risk of P2P online loan platforms is still high, which needs to be further strengthened. The credit risk management level of each platform is quite different, and the top three grey correlation degrees are Bojin Loan, Zhangzhong Wealth and Smiling Face Finance. Among the platforms ranked in the bottom 20, the correlation degree is all above 0.6. The online loan platform with the greatest credit risk is Hexin Loan, with the correlation degree as high as 0.77503.

V. CONCLUSIONS AND SUGGESTIONS

A. *Conclusions*

In China, there are two paradoxes in P2P industry: "rigid payment and investors' refusal to take risks" and "reverse screening of investment returns and risks". First of all, according to the normal P2P model, transactions are person-to-person, it should be the investor to decide whether to lend to the borrower, the risk is borne by themselves, P2P platforms do not assume the obligation of payment, the government does not allow the P2P platform of rigid payment. But in order to ensure the long-term development of P2P online loan platform in China, it is necessary to pay rigidly. Secondly, generally speaking, the capital cost of P2P online loan platforms is above 20%, and considering the provision of some bad debts, the capital cost will reach above 30%. In the case of the real economy recession, normal enterprises cannot afford the high financing cost, thus the credit of borrowers and the quality of their assets cannot be guaranteed.

B. *Suggestions*

Aiming at the above two paradoxes and combining with the empirical analysis results, this paper puts forward the following four suggestions:

1) Establishing a dynamic regulatory model and constantly improving the regulatory policy and legal system: At present, China has initially formed a "1+3" supervision system for P2P online loan, and the introduction of various new regulations has to some extent filled the policy gap. However, due to the obvious differences in the development status of P2P online loans in different macroeconomic environments, it is necessary to establish a dynamic regulatory model for different periods. First, relevant departments should set access standards, raise the threshold of the industry, purify the environment of P2P online loan industry from the source, and strengthen the platform credit base. Secondly, the objects of supervision should be clarified to avoid the problem of ambiguous institutional positioning, and platforms should be prohibited from conducting illegal operations to absorb public deposits in disguise. Finally, platform market withdrawal mechanism should be established to provide important protection for the legitimate rights and interests of consumers.

2) Improving the risk reserve system of P2P online loan platforms: The risk reserve system is an important system to ensure the healthy development of P2P online loan platforms. It meets the requirements of the supervision platform and the borrower's credit isolation, and has a solid legal basis. At present, the risk reserve system promotes the repayment of defaulted loans to a large extent, but most platforms still have problems such as unclear positioning of risk reserve, unclear risk classification and loose fund custody. Therefore, first of all, on the premise of information intermediary positioning and supervision of P2P online loan platforms, it is clear that the ownership of risk reserves should belong to the platform and the source of such funds should be its own operating income. Secondly, bank trusteeship of special account for risk reserve should be strictly implemented, so as to avoid the confusion between the platform's own funds and risk reserve, and to prevent the occurrence of "run" and even systematic financial risks. Finally, optimization without commitment advances, borrowing matched model, control the degree of dispersion between borrowers and investors, investors, single investment quota and the number of borrowers, lending to single allows network platform to recover the loan default charge must be paid when borrowing, make the platform for pure information intermediary role, reduce the risks.

3) Strengthening the management of credit loans and mortgage loans: P2P platform business should focus on mortgage loans, because it cannot fully understand the credit information of borrowers, there is a great risk of default. In contrast, mortgages are less risky, and online lenders can stop losses by disposing of collateral if the borrower defaults. Therefore, the platform business is suitable for mortgage loans to effectively reduce the risk.

4) Improving personal credit system, credit investigation system and credit breach mechanism: At present, complete personal credit system has not been established, and there is no third-party authority to make personal credit score. Because, in order to fully grasp the real and effective information of the borrower to prevent the risk, it is necessary to establish a sound credit investigation system and disciplinary mechanism. P2P online loan platforms can refer to the personal credit rating system of

developed countries and select rating indicators for qualitative evaluation according to the "5C" criterion.

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