

Influence of Borrower Information Asymmetry on P2P Lending Interest Rates: A Principal-Agent Perspective

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Abstract:

This study employs principal-agent theory to examine the impact of various factors on the interest rates of three stakeholders in online loan transactions: investors, borrowers, and the lending platform, under the condition of an expected net income of zero. By elucidating the mechanisms through which these factors influence interest rates, investors can assess the appropriateness of the rates offered by the lending platform and gauge the associated risk levels. The analysis reveals that the likelihood of a borrower's loan being approved is crucial in determining online loan interest rates. Borrowers can affect investors' perceptions by withholding information about their success rates, thereby influencing the interest rates. Additionally, the income generated by the platform and its management of funds indirectly affect online loan interest rates through the platform's probability of sustained operation.

Keywords:

Peer-to-Peer net loan platform; Principal agent; Herd Effect; P2P net loan interest rate.

1. Introduction

Since "Ezubao", "Qianbao", "Shanlin Finance" and other large-scale online loan platforms involving huge amounts of money have been thundered one after another, the security and existence of online loan platforms have been enthusiastically discussed by researchers. However, the daily thunderstorm of the P2P online loan platform continues. In July 2020, following the thunderstorm of "Aiqianjin", the longest and best-known online lending platform, the "WEI" was also put on file for investigation. With the thunderstorm of the two P2P online loan platforms one after another, the security of the online loan platform has once again attracted the attention of investors. at the same time, there is a significant difference in interest rates in the current online loan market. the rationality of the interest rate provided by the online loan platform is also one of the important indicators to judge whether the platform has the risk of running away. According to the data of China online Lending Industry Annual report 2019 released by online loan Home, the number of lenders and borrowers in China's online loan market in 2019 was 7.26 million and 11.56 million respectively, although the number decreased compared with the previous year. However, the number of participants in the online loan market is still staggering, and most individual investors usually lack professional investment knowledge, so it is difficult to make rational analysis and choice in online loan investment. In addition, the information disclosure of the online loan platform is incomplete, and investors often make irrational investment decisions. this paper is based on the irrational behavior of the online loan participants and uses the principal-agent theory. in order to get the action mechanism of the relevant factors affecting the online loan interest rate, so as to better guide the online loan investment participants to measure the rationality of the online loan

interest rate provided by the platform, and to identify whether the online loan platform has the risk of "running away". So as to improve the protection of investment funds.

2. Related researches

At present, there are many researches on P2P network loan platform, most of which focus on the research of network loan risk. Zheng (2017) and others proposed that platform investors should first consider the risks existing in the online loan platform when identifying investment risks, and then consider the specific borrowing projects and the credit risks of borrowers. Therefore, It is of great significance to study the risk identification of online loan platform.

In view of the problem of evaluating the risk of the online loan platform, scholars mainly evaluate and rank the online loan platform by constructing the evaluation index system of the platform, so as to screen out the competitive online loan platform. To reduce the platform run and other risks faced by investors. Guo and Chen (2015) constructed a comprehensive evaluation system of network lending platform, and used factor analysis to measure the comprehensive competitiveness of each platform. Xu and Cao (2016) establish a "importance- competitiveness" diagnosis model for individual P2P network loan platform according to the eight elements that make up competitiveness, and use the model to evaluate the competitive advantages and disadvantages of the platform. Cao (2016) evaluates the standard development degree of P2P network loan platform from four dimensions: platform scale, operation guarantee, transparency and guarantee type, so as to enhance the ability of investors to identify the platform. Xu and Zhang (2017) established a credit risk assessment model of online loan platform based on AHP, which provides a basis for investors to choose a platform, so that investors can make a rational choice between income and risk according to their personal preferences.

In view of the "herding effect" that generally exists in investment activities. Herzenstein (2011) found that the herding effect is weak at the initial stage, and the herding effect will jump to a higher level as the proportion of investment participation exceeds a certain value. The herding effect is persistent, and the herding effect of investors is that they tend to invest and bid for a large number of loans. Wang and Greiner (2010) proves that the herding effect in P2P network loan will cause the problem of high investment concentration and reduce the investment return and capital utilization efficiency. Ceyhanet al. (2011) studies the behavior of investors in Prosper platform. The results show that the herding effect of investors is affected by borrowing interest rate, successful bidding probability and financing success probability. Wang (2017) points out that the participants in China's personal online loan market are long-tailed people who lack professional investment theoretical knowledge, risk identification and risk-bearing ability. It is extremely prone to irrational behavior. Li et al. (2013) found that the characteristics of loan order, borrower and borrower's social capital significantly affect the success rate of loan, and the herding effect of investors is obvious.

The herding effect in the online loan market aggravates the degree of information asymmetry in the online loan transaction, and the principal-agent theory is an effective way to solve the information asymmetry, so many scholars have studied the principal-agent relationship in the online loan environment. The principal-agent problem widely exists in all aspects of P2P network loan, and scholars have done a lot of research on the principal-agent problem in P2P network loan. The main difference is the number of subjects involved in the principal-agent system. It can be divided into two participants (that is, investors and platforms), three participants (that is, investors, borrowers, and online lending platforms) and four participants (that is, investors, borrowers, online lending platforms and regulators) principal-agent relationship. Tan (2014) through the construction of principal-agent model, it is concluded that the signal transmission game model can solve the problem of adverse selection in network loan,

and the moral hazard problem in network loan can be prevented by introducing credit guarantee. Xu (2017) pointed out the complex principal-agent relationship among investors, platforms and borrowers in online loan activities, and analyzed the risk formation mechanism of online loan platform by using principal-agent model. Zheng (2015) constructs a principal-agent model including borrowers, platforms, guarantee institutions and investors from the perspective of platform operation mode, and compares the specific situation of information asymmetry under different operation modes.

At present, there are some studies on the influencing factors of P2P network loan interest rate, but few studies have pointed out the influence of various factors on the interest rate of P2P network loan. On the other hand, the rationality of the interest rate provided by the online loan platform is one of the important indicators to judge whether the platform has the risk of running rate, which is necessary for further research. This paper takes the irrational behavior of online loan investors into account, on the basis of principal-agent theory and the introduction of borrower success rate, borrower investment success rate, platform long-term existence rate, investment funds, transaction costs, borrower investment return rate, platform operation period, agent income, recharge uninvested funds and so on. This paper explores the influence mechanism of various factors on the investment return rate of investors, borrowers and online loan platforms when the expected net income is 0, and hopes to provide some guiding suggestions for online loan investors.

3. Problem Description

In P2P network loan trading activities, the direct participants are investors, borrowers and net loan platforms. Whether it is intermediary platform or creditor's rights transfer platform, investors invest in borrowers' loan projects and transfer the right to the use of funds, which is an indirect principal-agent management, and the net loan platform plays an intermediate role. The net loan platform is not only the direct fund recipient of investors but also the direct fund recipient of borrowers, which is a direct principal-agent relationship. In other words, there are multiple principal-agent relationships among the three parties involved in online loan transactions. Because the three participants have their own goals, there must be contradictions between them.

Suling Feng and Chunxiao Huang (2017) point out that there are two goals for net loan platforms: short-term profit and long-term development, the latter is relatively more important. There is little correlation between investors and net lending platforms for the first goal, while for the second goal, the correlation is extremely high. Borrowers have a high degree of relevance to the first goal of the net loan platform, but it is not necessary for the second goal. This is the main contradiction of these two kinds of principal-agent relationship.

For investors, the goal is to achieve the highest possible return on investment. However, there are strict prerequisites for investors to successfully obtain returns: the successful investment of funds, the successful investment of borrowers to obtain the expected returns, and the long-term existence of the platform. If any of the conditions are not met, the goal cannot be achieved.

The first goal of the borrower is to obtain the loan successfully, and the second is to obtain the return on the investment successfully. Most participants in the net loan market are ordinary people, and very few are professional financial practitioners. It is obviously not enough to analyze the investment behavior of investors in the net loan market from the perspective of rational people. Scholars point out that ordinary investors in financial markets usually have irrational behaviors such as overconfidence, bounded rationality, gambler psychology, conformity psychology, self-interest prejudice and so on. As the product of the combination of Internet and finance, there is a serious problem of information asymmetry in the net loan market. Considering the decision-making behavior of the limited rational investors in the

principal-agent relationship of the net loan platform, this paper concludes how the net loan platform and investors should take measures to obtain the participation of investors.

4. Model Establishment

With the promotion of financial innovation, P2P net loan industry has emerged a large number of platforms with different scales and different developments, for example, according to the background of the platform, there are banking system, listing system, state-owned assets department and private department, according to the classification of the object of the platform, there are creditor's rights transfer platform and creditor's rights non-transferable platform, and according to whether there is collateral or not, it can be divided into credit guarantee platform, third-party guarantee platform and guaranty platform. To simplify the model, the following assumptions are made:

Hypothesis 1: The intermediate fees charged by the platform to investors are transferred to borrowers through interest rates, that is, the platform does not charge intermediary fees to investors.

Hypothesis2: The platform charges a fixed fee to the borrower. The platform requires borrowers to take credit guarantee.

Hypothesis3: The platform operates in the mode of creditor's rights transfer. Hypothesis 4: The platform does not take any safeguard measures such as risk reserve.

Hypothesis 5: Assume that the borrower borrows money for investment activities, the use of consumption is equivalent to the investment of one's own funds. The borrower's probability of successful borrowing is P_1 , the borrower's probability of successful investment project is P_2 , and the platform's probability of long-term existence is P_3 .

On the premise of the above assumptions, based on the principal-agent relationship between P2P net loan platforms, this paper takes P2P net loan platforms as the main stakeholders to analyze.

4.1. Model for investors

For investors, the income of investors participating in the platform is $D \cdot R_1 R$, where D is the investment fund, R_1 is the borrower promises the interest rate, ($R_1 R$) is the modified rate of return is the adjusted rate of return of capital, which R is the rate of return of capital. The loss of the investment platform is $D \cdot (1R_1)$.

Revenue expectations:

$$EI = P_1 \cdot P_2 \cdot P_3 \cdot D \cdot (R_1 R) \quad (1)$$

Loss expectation:

$$CI = 1 - P_1 \cdot D \cdot R_1 P_1 \cdot 1 P_2 \cdot P_3 \cdot D \cdot 1 R_1 \quad (2)$$

4.2. Model for borrowers

The proceeds are related to the use of the funds for borrowers. The borrower has two kinds of correlation probability, the loan success rate P_1 and the project success rate P_2 . Assuming that the borrower invests the project expected investment rate of return is R_2 , the investment principal is the borrowed capital deducts the transaction cost with the platform, ($D - C$).

Revenue expectations:

$$EB = P_3 \cdot P_2 \cdot D \cdot C \cdot R_2 D \cdot 1 R_1 P_3 \cdot P_2 \cdot D \cdot C \cdot R_2 \quad (3)$$

Loss expectation:

$$CB = 0 \quad (4)$$

The borrower expects the direct loss to be 0 because of taking credit guarantees.

5. Model analysis

According to the income and cost functions of investors, borrowers and net loan platforms in online loan transactions, under the assumption of the expected returns of investors, borrowers and online loan platforms are 0, this paper analyzes the relationship and influence mechanism of the parameters in the online loan transaction.

5.1. Analysis of investors

When the expected return of the investor is 0, that is, (1)-(2) = 0, it can be obtained:

$$R_1 = \frac{P_1 P_1 * P_2 * P_3 P_1 * P_2 * P_3 * R}{2 P_1 * P_2 * P_3 1} \quad (5)$$

From the expression R_1 , we can see that when the final repayment probability of the investor is greater than 0.5, the return of the investor can be positive, indicating that the investor can get the return. That is to say the three probability values are at least greater than 0.5.

From corollary 1, from the point of view of investors, the higher the borrower's successful borrowing probability, indicating that the borrower's credit evaluation results are better, investors bear less risk, so the borrower's promised rate of return (that is the expected rate of return of investors) is lower.

Due to the existence of the herding effect, the borrower's borrowing success rate has increased, and the rate of return on investment should be reduced. This well confirms the conclusion put forward by the Michal Herzenstein study that the herding effect also has a reverse effect on the borrowing rate.

Corollary 2 When the investor's investment net income is 0, and the other conditions are unchanged, the higher the probability of the borrower's investment success, the lower the investor's investment return rate.

It is proved that the partial derivatives of R_1 to P_2 ,

From corollary 2, under the premise that the borrower can basically raise funds, the higher the success rate of the project, the borrower's promised rate of return will be reduced. In fact, investors believe that the higher the success rate of the project invested by the borrower, that is the smaller the risk faced by the investor, the lower the required rate of return on investment.

Jinyan Hu and Weishi Song (2018) confirmed that there is a positive correlation between the interest rate and the default rate of the subject matter of the online loan. The higher the borrower's investment success rate, the lower the default risk, so the lower the interest rate of the subject matter of the loan, that is, the lower the rate of return promised by the borrower. The conclusion of this study can well prove the content of corollary 2.

Corollary 3 When the net income of investors' investment is 0, and the other conditions are unchanged, the higher the probability of continuous operation of the online lending platform, the lower the investor's return on investment.

When the borrower's expected rate of return is 0, that is, (3)-(4) = 0, it can be obtained:

$$R_1 = \frac{P_2 * D C * R_2}{P_3 * D} 1 \quad (6)$$

Corollary 4 When the borrower's net investment income is 0, and the other conditions are unchanged, the higher the probability of long-term existence of the platform, the lower the borrower's promised rate of return.

It is proved that the partial derivatives of R_1 to P_3 ,

$$\frac{\partial R_1}{\partial P_3} = \frac{P_2 * D * C * R_2}{P_3^2 * D^2} < 0, \text{ which is always true, Corollary 4 is proved.}$$

From corollary 4, the lower the possibility of long-term development of the platform, the higher the interest rate offered by the borrower. Borrowers have gambler psychology, borrowers can more successfully obtain funds by promising higher interest rates, and once there is a problem with the platform, loans obtained through higher interest rates will not be able to recover.

Corollary 5 When the borrower's net investment income is 0, and the other conditions are unchanged, the higher the success rate of the borrower's investment, the higher the borrower's promised rate of return.

It is proved that the partial derivatives of R_1 to P_2 ,

$$\frac{\partial R_1}{\partial P_2} = \frac{D * C}{P_2 * P_3 * D} > 0, \text{ which is always true, Corollary 5 is proved.}$$

From corollary 5, for borrowers, the higher the probability of project success, the greater the possibility of obtaining income from borrowing investment. In order to obtain funds, borrowers can raise the borrowing interest rate as much as possible to ensure the possibility of obtaining funds.

Corollary 6 when the net income of the borrower's investment is 0, and the other conditions are unchanged, the higher the borrower's loan amount, the higher the promised rate of return. It is proved that the partial derivatives of R_1 to D ,

From corollary 6, the larger the amount of borrowing for borrowers, the higher the risk for investors, and borrowers must pay higher interest rates in order to obtain funds.

Yi Guo (2011) pointed out that the characteristics of loan amount and other characteristics will have a positive impact on the loan interest rate in online lending, which well verifies the correctness of corollary 6.

Corollary 7 when the borrower's net income on investment is 0, and the other conditions are unchanged, the higher the borrower's borrowing cost, the lower the promised rate of return. It is proved that the partial derivatives of R_1 to C

From corollary 7, for borrowers, the higher the cost of obtaining funds, the lower the willingness to obtain funds, so the rate of return on commitment is also reduced accordingly.

Corollary 8 when the borrower's net income on investment is 0, and the other conditions are unchanged, the higher the borrower's rate of return on investment, the higher the borrower's promised rate of return.

It is proved that the partial derivatives of R_1 to R_2 ,

$$\frac{\partial R_1}{\partial R_2} = \frac{P_2 * D * C}{P_3^2 * D^2} < 0, \text{ which is always true, Corollary 8 is proved.}$$

D

From corollary 8, the higher the rate of return of the borrower's investment project, the stronger the borrower's willingness to borrow, and the higher the promised borrowing rate.

It is found that there is a direct contradiction in the research process of taking the investor and the borrower as the interest center respectively. From the point of view of investors, the relationship between R_1 , P_2 , P_3 is the same, but from the point of view of borrowers, the relationship between R_1 , P_2 , P_3 is the opposite. This direct contradiction theoretically verifies that there is information asymmetry in the process of online loan investment. Borrowers can influence investors' judgment by concealing their investment success rate, thus exerting a reverse effect on interest rates.

Moreover, according to the difference between the investor and the borrower for the information of R_1 they need to obtain, the investor requires more information parameters than the borrower, which also shows that the investor is at a disadvantage compared with the borrower.

We can see that the long-term existence probability of the platform is negatively correlated with the recharged not-invested funds of the platform management, that is to say, the higher the amount of investor's recharge and non-investment in platform management, the more likely the P2P net loan platform is to have moral hazard, and the higher the probability of platform "running".

Combined with the relationship between corollary 10 and corollary 2, the positive correlation between P_3 and P_2 can be deduced. Only if the borrower invests successfully can the loan be repaid successfully, and the funds of the platform can operate normally, thus ensuring the sustainable operation of the platform. Because there is no positive correlation between R_1 and P_1 , it is not possible to determine the stable correlation between P_3 and P_1 . The borrower's successful loan cannot guarantee the normal operation of the platform funds, so there is no inevitable relationship between the borrower and the continuous operation of the platform.

Table 1. Table of effects of interest rates on net loans

Factors	Rate of return on net loan investment R_1		
	Investor (direct)	Borrower (direct)	Net loan platform (indirect)
Loan success rate(P_1)	-		
investment success rate(P_2)	-	+	
Long-term existence rate(P_3)	-	-	
Investment fund(D)		+	
Transaction cost(C)		-	
Rate of return on investment(R_2)		+	
operation periods(t)			—
Agency income(π)			+
Recharge uninvested funds(N)			+

6. Conclusions

According to the income and cost functions of investors, borrowers and net loan platforms in the established online loan transactions, under the assumption that the expected returns of investors, borrowers and net loan platforms are 0, obtaining the relationship between the parameters in the online loan transaction and the influence mechanism. Through the establishment and analysis of the model, the following conclusions are drawn,

- (1) From the point of view of investors, the rate of return on investment is negatively correlated with the borrower's successful borrowing probability, and the rate of return on investment is also negatively correlated with the borrower's probability of successful investment and the probability of sustainable operation of the platform.
- (2) From the borrower's point of view, the investor's return on investment is negatively correlated

with the probability of continuous operation of the online loan platform, and the investor's rate of return on investment is positively correlated with the borrower's investment success rate and borrower's rate of return on investment. The rate of return of investors, that is, there is a contradiction with the borrower's cost to the borrower's investment success rate or the probability of continuous operation of the platform, and this direct contradiction proves that there is information asymmetry in the process of online loan investment in theory. Borrowers can influence investors' judgment by concealing their investment success rate, thus exerting a reverse effect on interest rates.

(3) From the online loan platform, because there is no stable relationship between the continuous operation probability of the platform and the number of people, it shows that there is no stable relationship between the number of platform investment and the borrower's promised rate of return; Platform agency income and platform management funds indirectly have a positive impact on the borrower's committed rate of return through the continuous operation probability of the platform.

The relationship between the rate of return on investment and the long-term probability of the platform depends on the selected reference subject. For investors and borrowers as trading subjects, the rate of return on investment is negatively correlated with the long-term probability of the platform, but there is a positive correlation for the online loan platform as an intermediary. The contradiction between the two fully shows that there is a balanced interest rate in the online loan market, which makes the interests of the three participants reach a stable state.

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