Research on Decisive Mechanism of Internet Financial Interest Rate

Shengdong Mu[1], Yixiang Tian[1], Li Li[1]

[1] *School of Management and Economics*, University of Electronic Science and Technology of China, Chengdu, Si Chuan, China, 614100

Abstract **— This article studies the decisive mechanism of the Internet financial interest rate. Considering the possibility of basic symmetry for the credit information in the internet financial market with the application and development of the big data technology, a Nash Bargaining Module is established in the article, which includes the main decisive factors of the Internet financial interest rate (the program natural risk, program rate of return, loan period, loan scale, loan urgency, operating capacities of the borrower, the competition of the credit market, and the regime risk) as variables for analysis of their effects on the internet financial interest rates. According to relevant researches, the uncertainty of the loan projects in themselves and the costs for the implementation of secured credit contracts, rather than the reverse selection and moral risks arising from information asymmetry, form the main issues of the Internet financial interest rate.**

Keywords - Internet finance, decisive mechanism of the Interest rate, Nash bargaining solution

I. INTRODUCTION

Interest rates are closely dependent on the development of Internet finance. Deposits, as the main passive liabilities for banks, constitute the main capital sources of commercial banks along with other active liabilities in the monetary market. The distortion of the deposit rates and the Internet technology development are the main reasons for the generation of Internet finance. As an essential impetus in economic development, Internet technology alters the financial operation modes significantly in aspects of payment modes, information processing and resource configuration. (Xie Ping, Zhou Chuanwei, 2012; Huang Xu et al, 2013). According to Chen Zhiwu (2014), Internet poses a great challenge for traditional banks and capital markets in the sense of channels, however, it has no difference from the products of banks and capital markets in structure and design; the essence of the finance stays the same, that is the time spread value exchange, and the credit exchange; it is the scope, number of people involved, amount and environment, rather than the essence of the financial transactions, that are changed by the Internet. Wu Xiaoqiu (2014), Xu Rong (2014) points out, Internet finance is an investment and financing structure built on the Internet platform with financing functions, basic and independent surviving spaces; in the aspect of generic matching, the Internet platform is characterized by higher coupling with the four main functions of the financial system, namely, payment and settlement, provision of price information, risk management, and resource configuration. In general, Internet finance covers both the financial businesses of non-financial Internet enterprises and businesses of financial institutions by the means of Internet in the board terms. While the Internet finance in the narrow terms refers only to financial businesses based on the Internet technologies by the Internet enterprises. The Internet finance in China currently is divided into Internet of finance and finance of Internet on the basis of the nature. Internet of finance refers to that traditional financial institutions utilizes Internet technologies to overcome the limits of time, space and physical network, so as to improve their businesses thoroughly, and provide various financial services by the Internet; finance of Internet, refers to that Internet enterprises which has nothing to do with the finance start to provide financial services. Exterior forces are affecting the finance irreversibly by the Internet, which causing significant reform in the financial industry (Li Haifeng, 2013). The theory of financial repression and deepening put forward by McKinnon and Shaw is one of the most important theories on liberalization of interest rates. It is common in developing countries to choose the wrong financial policies and systems. To be specific, it is featured by enforcement intervention over the financial activities by the government, imposing of low interest rates and exchange rates artificially, the so-called "financial regulation".

Researches on interest rate control include that, the effects of the removal of interest rate control on the financing costs and financing efficiencies in the economy by Feyzio lu (2009), and the transmission procedures of monetary policies with interest rate control by He Dong and Wang Honglin (2012). Regarding the bank risks in the interest rate liberalization, the article mainly analyzes the risks of Chinese banks in the beginning of the interest rate liberalization (Huang Jinlao, 2001; Xie Yunshan, 2005). Hoff and Stiglit z (1997) hold that due to the market

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segmentation and incomplete information, expensive contract implementation is likely to cause market failure which inhibits risk management and results in costs differences during the screening, supervision of borrowers and loan implementation, causing the uprising of the interest rates.

The interest rate control forms the impetus of the prosperity of the internet finance. However, there are few references on the decisive factors of the interest rates. The article aims to build a Nash Bargaining Module with general symmetry information, which includes the main decisive factors of the Internet financial interest rate, including the risk of credit default (such as program natural risks, adverse selection and moral risks), the transaction cost, the loan scale, the competition of the Internet credit market, the regime risk, the formal financial interest rate, the operating capacity of the borrower, the loan period, and the loan urgency in the model as variables to analyze the decisive mechanism of the Internet financial rates.

II. Module

A. *Selection of Benchmark Model*

It is possible to extend the channels effectively, to manage the credit risks for customers and to solve the information asymmetry issues with the help of big data in the Internet finance. As long as the Internet finance is concerned, there are a few functions worth highlighting:

(1) The traditional marketing channels are extended effectively by big data analysis. Channels of commercial banks are not limited to traditional channels, but extend to various interconnected channels with new customer touch points added, such as social networking sites. Commercial banks shall spare no effort to integrate the electronic channels such as portal websites, on-line banks, telephone banks, mobile banks, and ATM, and to build on-line comprehensive financing marketing service platforms by taking advantage of new media including the microblog, WeChat and social network sites etc., to facilitate product promotion, idea collection, customer services and marketing services. Typical examples include: WeChat Credit Card Bills issued by China Merchants Bank are environment friendly and efficient with illustrations and pictures. The V payment platform issued by China Everbright Bank on the Sina Microblog makes it possible for customers to pay their bills by microblog. Shanghai Pudong Development Bank plans to launch a national NFC mobile payment platform and aims to make the Bank leading in the mobile finance.

(2) The credit risks of customers are managed through dig data analysis. Considering that the critical information and activities of individuals or organizations are all recorded and the above data footprints are accessible by social network sites and search engines, it is feasible to manage the customer credit by big data analysis. Currently, the customer management for credit services of small and micro businesses is mainly based on big data, which collects various information of customers at low cost by the Internet for analysis and exploration, and judgment of customer qualification. Typical cases include: the business credit information in the Alibaba Credit Services is collected by analysis of business activities. The data to be analyzed covers the hits, across-store hits, order flows and mutual rating information for the seller and the buyer. Each transaction on the e.ccb.com will be used as important proof for customer credit rating by China Construction Bank. The Citibank accesses the credit records and histories of customers by social network sites and public websites.

(3) The information asymmetry issues are solved by the use of big data, e.g., the development of the Internet gradually reduces the asymmetry extent; the P2P platform makes direct transaction between the borrower and lender possible by the electronic platform; financial disintermediation becomes the trend for financial development.

Now that the information asymmetry is no longer an issue for the Internet finance, we will consider other factors affecting borrowing rates for the Internet finance, including: natural risks of the loan program, program rates of return, loan periods, loan scales, loan urgency, operating capacities of the borrower, the competition of the credit market, and regime risks. These factors determine the capacity to borrow for the borrower, in other words, the Internet financial interests rates are mainly dependent on the strength gambling between the borrower and lender.

Nash (1950) put forward the following Symmetric Nash Bargaining Solution:

$$x^{*} = ArgMax_{x\in S}\left[U_b(x)-B_b\right]\left[U_l(x)-B_l\right]$$

Where $U_b(x)$ and $U_l(x)$ refer to utility functions of the bargaining parities under scheme x, B_b and B_l refer to the Utility of Breakdown Point of both parties, x^{*} is the Pareto-efficiency scheme and S is the sum of possible schemes.

Kalai and Smorodinsky (1975) presented the Drop Asymmetric Nash Bargaining Solution by relaxing conditions for the Symmetric Nash Bargaining Module.

$$x^{*} = ArgMax_{x\in S}\left[U_b(x)-B_b\right]^{a}\left[U_l(x)-B_l\right]^{(1-a)}$$

Where a and b refer to the relative bargaining power for the bargaining parties.

By comparing the above two bargaining models, general symmetry of the borrower and lender of the Internet finance is achieved through big data analysis. The Drop Asymmetric Nash Bargaining Model is selected as the theory model for the analysis of borrowing rates for the Internet finance.

B. *Establishment of the Module*

The following fundamental assumptions are made for the Internet financial loaning transactions to simplify the analysis: (1) general symmetry is achieved for basic information of the borrower and the lender, (2) the loan is intended for operative investment, and the self-owned capital and the loans in the Internet financial market form the sources for all capital of operative investment; (3) the benefits from the loans are used to repay the principals and interests of the loans; (4) the issues of credit risks have been solved, that is to say the borrower will be certain to repay the principals and interests of the loans with the benefits of the loans; (5) there is no explicit mortgage or guarantee.

A specific Internet financial credit transaction model is established then. For example, an enterprise owner (or a farmer) owns an vestment project, and the rate of return for the project is a random variable P, $P \in [0, W]$, where W is a number larger than 0, and $f(P)$ is the density function of p, then the average rate of return for the program is $\overline{P} = \int_0^W Pf(P)dP$. Suppose the enterprise owner (or the farmer) doesn't have sufficient capital, a loan is necessary, and the loan ratio is r, $r \in [0,1]$, and a lender is willing to provide the loan by Internet and the bargaining loan rate is e, then the benefits distribution information of both the borrower and lender upon the end of the loan is as follows:

Where $P \le r(1+e)$, the benefit of the borrower is 0 and the benefit of the lender is P;

Where $P \ge r(1+e)$, the benefit of the borrower is $P - r(1+e)$ and the benefit of the lender is $r(1+e)$.

The loan rate is the result of bargaining between the borrower and the lender based on their bargaining positions respectively. Suppose the relative bargaining power of the borrower is a, and the relative bargaining power of the lender is $(1-a)$, and $a \in (0,1)$, and a is the function of the total number of borrowers n, and the total number of lenders m, the loan period t, the loan urgency u, the operation capacity of the borrower f and the regime risk level v, i.e., $a = a(n, m, t, u, f, v)$. Apparently, the less the lenders are in the market, the higher the relative bargaining power of the borrower is, and vice versa; and the extension of the loan term, the urgency the loan, and the increase of the regime risk will decrease the bargaining power of the borrower (Jiang Shuxia, Qin Guolou, 2000; Zhang Jianzhong, Yuan Zhonghong, Lin Ping, 2002), then:

$$\partial a/\partial n < 0, \ \partial a/\partial m > 0, \ \partial a/\partial t < 0, \ \partial a/\partial u < 0,$$
$$\partial a/\partial f > 0, \ \partial a/\partial v < 0$$

Suppose U_b and B_b are the Utility Function and Utility of Breakdown Point of the borrower respectively, U_l and B_l are the Utility Function and Utility of Breakdown Point of the lender respectively. Considering that it is very difficult to quantify the utility, the Utility Function can generally be replaced by the benefit (or cost) function under the hypothesis of "economic person",

then:

$$U_b = \int_{r(1+e)}^{W} [P - r(1+e)] f(P) dP$$

$$U_l = \int_0^{r(1+e)} Pf(P)dP + \int_{r(1+e)}^{W} r(1+e) f(P) dP$$

The Utility of Breakdown Point B_b and B_l can be expressed by the opportunity cost and the transaction cost. Suppose s is the bank interest rate of the same period, and equals the Shanghai Interbank Offered Rate (hereinafter as Shibor), C_b is the transaction cost of the borrower, and C_l is the transaction cost of the lender, then B_b and B_l can be expressed by:

$$B_b = C_b + (1-r)(1+s), \ B_l = C_l + r(1+s)$$

III. Analysis of Decisive Mechanism of Interest Rates

Based on the above analysis and assumption, the borrowing rate e^* under Pareto-efficiency situation is a Drop Asymmetric Nash Bargaining Solution, with the following algebraic programming expressions:

$$\underset{e}{Max}[U_b(e) - B_b]^a [U_l(e) - B_l]^{1-a}$$
$$s.t. \ U_b(e) - B_b \ge 0, \ \ U_l(e) - B_l \ge 0$$

The first order optimal conditions are described as follows:

$$\left[(U_b - B_b)^a (U_l - B_l)^{1-a}\right]^l = a(U_b - B_b)^{a-1}(U_l - B_l)^{1-a} U_b^l + (1-a)(U_b - B_b)^a (U_l - B_l)^{-a} U_l^l + 0 \quad (1)$$

$$U_b = \int_{r(1+e)}^{W} [P - r(1+e)] f(P) dP \quad (2)$$

$$U_l = \int_0^{r(1+e)} Pf(P)dP + \int_{r(1+e)}^{W} r(1+e) f(P) dP \quad (3)$$

$$\frac{\partial U_b}{\partial e} = -r^2(1+e) f[r(1+e)] - r\int_{r(1+e)}^{W} f(P)dP + r^2(1+e) f[r(1+e)]$$
$$= -r\int_{r(1+e)}^{W} f(P)dP$$

$$\frac{\partial U_l}{\partial e} = r^2(1+e) f[r(1+e)] + r\int_{r(1+e)}^{W} f(P)dP - r^2(1+e) f[r(1+e)]$$
$$= r\int_{r(1+e)}^{W} f(P)dP$$

Considering $\dfrac{\partial U_b}{\partial e} = -\dfrac{\partial U_l}{\partial r}$, then $U_b^l = -U_l^l$

Plug expression (2), (3) and (4) into expression (1) to achieve the first order maximum conditions:

$$\int_{r(1+e^*)}^{W} [P - r(1+e^*)] f(P) dP - a(\overline{P} - B_b - B_l) - B_b + 0 \quad (5)$$

Plug expression $B_b = C_b + (1-r)(1+s)$, $B_l = C_l + r(1+s)$ into expression (1), then:

$$\int_{r(1+e^*)}^{W} [P - r(1+e^*)] f(P) dP - a(\overline{P} - C_b - C_l - s - 1) - C_b - (1-r)(1+s) + 0 \quad (6)$$

The first order conditions imply that the optimum interest rate e^* is dependent on the natural risk of the loan program, the expected rate of return of the program, the loan ratio, the transaction cost of the lender, the transaction cost of the borrower, the bank interest rate, and the relative bargaining power of the borrower(the loan period, the operating capacity of the borrower, the loan urgency, the competition of the credit market, and the regime risk), i.e., the explicit function under the first order conditions is $e^* = e^*\left(A, a, s, r, \overline{P}, C_b, C_l\right)$. Where, $A = \int_{r(1+e^*)}^{W} f(P)dP$, refers to the probability function of zero loss for the lender. Evidently, we can find a negative correlation between A and the program natural risks, and we can also get the natural risk level of the loan program.

The effects of the above factors on the Internet financial interest rates are further analyzed in accordance with the first order optimum conditions, i.e., the function $e^* = e^*\left(A, a, s, r, \overline{P}, C_b, C_l\right)$ in the following.

Proposition I. There is a positive correlation between the Internet financial interest rate and the natural risk level of the loan program. The lender is likely to demand corresponding risk premiums based on the natural risk level of the program.

Demonstration: The probability function of zero loss for the lender is $A = \int_{r(1+e^*)}^{W} f(P)dP$, take the derivative with respect to e^* in the function $A = A\left(e^*\right)$, and the derivative is less than 0:

Due to $\dfrac{\partial A}{\partial e^*} = -rf\left[r\left(1+e^*\right)\right] < 0$, then: $\dfrac{\partial e^*}{\partial A} < 0$

According to $\partial e^* / \partial A$, the Internet financial interest rate is a decreasing function of the probability of zero loss for the lender. The probability of zero loss for the lender is qualified to be used to evaluate the natural risk level of the loan program. In other words, the lower the program natural risk is, the higher the probability of zero loss for the lender is; and vice versa. As a result, there is a positive correlation between the Internet financial interest rate and the natural risk level of the loan program. The proposition I that the lender is likely to demand corresponding risk premiums based on the natural risk levels of the programs is correct.

In the Internet financial market, general information symmetry is achieved between the loaner and the borrower through the big data system. In the event of the loan, the lender has already had a basic understanding of the loan risks (i.e., ex-ante risks). Therefore, relevant strategies will be taken by the lender for the loan, that is, they will demand different borrowing rates on the ground of different natural risk levels of loan programs. Higher interests are demanded for loan programs with higher natural risks to be used as the premiums for the risk borne by the lender for the loan.

Proposition II. There is no simple positive correlation between the Internet financial interest rate and the expected rate of return for the loan program.

Demonstration: In expression (5) under the first order optimum conditions, the decisive function of the optimum interest rate is defined implicitly, $e^* = e^*\left(\overline{P}\right)$. By using the implicit function theorem, we can get the relationship between the optimum interest rate e^* and the expected rate of return for the loan program $\overline{P}$. Considering $\overline{P} = \int_0^W Pf(P)dP$, it is inappropriate to take the derivative with respect to $\overline{P}$ in expression (5) only. It is also necessary take the derivative with respect to $\overline{P}$ in $f(P)$. As $f(P)$ is an abstract function, it is impossible to get the relationship between $f(P)$ and $\overline{P}$ directly. As a result, we will simplify $f(P)$ into a specific normal distribution function with a standard deviation of σ (normal distribution is very representative).

Suppose: $f(P) = \dfrac{1}{\sigma\sqrt{2\pi}} \exp\left[-\dfrac{\left(P-\overline{P}\right)^2}{2\sigma^2}\right]$, and $W \to +\infty$, and plug the above expressions into expression (5) under the first order optimum conditions:

$$\int_{r(1+e^*)}^{+\infty}\left[P - r\left(1+e^*\right)\right]\left[\frac{1}{\sigma\sqrt{2\pi}}\exp\left[-\frac{\left(P-\overline{P}\right)^2}{2\sigma^2}\right]\right]dP - a\left(\overline{P} - B_b - B_l\right) - B_b = 0$$

Suppose:

$$F\left(\overline{P}, e^*\right) = \int_{r(1+e^*)}^{+\infty}\left[P - r\left(1+e^*\right)\right]\left[\frac{1}{\sigma\sqrt{2\pi}}\exp\left[-\frac{\left(P-\overline{P}\right)^2}{2\sigma^2}\right]\right]dP - a\left(\overline{P} - B_b - B_l\right) - B_b$$

, take the partial derivative with respect to $\overline{P}$ and e^* in $F\left(\overline{P}, e^*\right)$, then:

$$F_{e^*}^{l}\left(\overline{P}, e^*\right) = -r\int_{r(1+e^*)}^{+\infty}\frac{1}{\sigma\sqrt{2\pi}}\exp\left[-\frac{\left(P-\overline{P}\right)^2}{2\sigma^2}\right]dP = -r\int_{r(1+e^*)}^{+\infty} f(P)dP = -rA$$

Suppose $D = r\left(1+e^*\right)$, and plug it into $F\left(\overline{P}, e^*\right)$, then:

$$F_{e^*}^{l}\left(\overline{P}, e^*\right) = \frac{1}{\sigma\sqrt{2\pi}}\left[\int_D^{+\infty}(P-D)\exp\left[-\frac{\left(P-\overline{P}\right)^2}{2\sigma^2}\right]dP\right]^{l} - a$$

$$= \frac{1}{\sigma\sqrt{2\pi}}\left\{\left[\int_D^{+\infty}(P-D)\exp\left[-\frac{\left(P-\overline{P}\right)^2}{2\sigma^2}\right]dP\right]^{l}\right.$$

$$\left. + \left[\int_D^{+\infty}\left(\overline{P}-D\right)\exp\left[-\frac{\left(P-\overline{P}\right)^2}{2\sigma^2}\right]dP\right]^{l}\right\} - a$$

$$= \frac{1}{\sigma\sqrt{2\pi}}\left[-\sigma^2\exp\left[-\frac{\left(P-\overline{P}\right)^2}{2\sigma^2}\right]\Bigg|_D^{+\infty} + \overline{P}\int_D^{+\infty}\exp\left[-\frac{\left(P-\overline{P}\right)^2}{2\sigma^2}\right]dP\right.$$

$$-D\int_{D}^{+\infty}\exp\left[-\frac{\left(P-\overline{P}\right)^2}{2\sigma^2}\right]dP\Bigg]^{l}-a$$

$$=\frac{1}{\sigma\sqrt{2\pi}}\Bigg[\left(D-\overline{P}\right)\exp\left[-\frac{\left(D-\overline{P}\right)^2}{2\sigma^2}\right]+\int_{D}^{+\infty}\exp\left[-\frac{\left(P-\overline{P}\right)^2}{2\sigma^2}\right]dP$$

$$+\left(D-\overline{P}\right)\exp\left[-\frac{\left(P-\overline{P}\right)^2}{2\sigma^2}\right]\Bigg|_{D}^{+\infty}\Bigg]-a$$

$$=\frac{1}{\sigma\sqrt{2\pi}}\Bigg[\left(D-\overline{P}\right)\exp\left[-\frac{\left(D-\overline{P}\right)^2}{2\sigma^2}\right]+\int_{D}^{+\infty}\exp\left[-\frac{\left(P-\overline{P}\right)^2}{2\sigma^2}\right]dP$$

$$-\left(D-\overline{P}\right)\exp\left[-\frac{\left(P-\overline{P}\right)^2}{2\sigma^2}\right]\Bigg]-a$$

$$=\int_{D}^{+\infty}\frac{1}{\sigma\sqrt{2\pi}}\exp\left[-\frac{\left(P-\overline{P}\right)^2}{2\sigma^2}\right]dP-a=\int_{D}^{+\infty}f\left(P\right)dP-a=A-a$$

Suppose: $\int_{r(1+e_0)}^{+\infty} f\left(P\right)dP-a=0$, then: as shown in Fig. 1, where $e^*<e_0$, $\partial e^*/\partial\overline{P}>0$, the interest rate is low, and expected rate of return of the program is positively correlated to the loan rate. where $e^*>e_0$, $\partial e^*/\partial\overline{P}<0$, the interest rate is high, and expected rate of return of the program is negatively correlated to the loan rate.

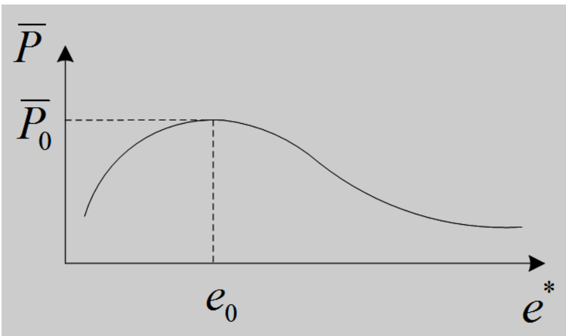

Fig.1 Relationship of the expected rate of return of the program and the interest rate

In the Internet financial market, general information symmetry is achieved between the loaner and the borrower. The natural risk level of the loan program is generally limited within an acceptable range, and both the lender and borrower have certain pricing power. In cases that the program system risk is lowered, the success probability of the program will be increased, so is the expected rate of return of the program. The lender is certain to adopt relevant strategies to demand the borrower to confer parts of the benefits by virtue of the pricing power. The expected rate of return of the program is positively correlated to the loan rate subsequently.

Where the program system risk is lowered to the maximum extent, the expected rate of return of the program reaches its highest value $\overline{P}_0$, and the loan interest rate then is e_0. If the program system risk grows, the success probability of the program will drop, so is the expected rate of return of the program. The lender is certain to demand higher interest rate by virtue of the pricing power to maintain the stability of $A\times r\left(1+e\right)$, so as to safeguard its own interests. The expected rate of return of the program is negatively correlated to the loan rate subsequently.

As a result, there is no simple positive correlation between the Internet financial interest rate and the expected rate of return for the loan program.

Proposition III. There is a positive correlation between the Internet financial interest rate and the transaction cost of the lender, and a negative correlation with the transaction cost of the borrower.

Demonstration: In expression (6) under the first order optimum conditions, the decisive function of the optimum interest rate is defined implicitly, $e^*\left(C_b, C_l\right)$. Take the derivative with respect to C_b, C_l in expression (6), then:

$$\frac{\partial e^*}{\partial C_l}=\frac{a}{r\int_{r\left(1+e^*\right)}^{W} f\left(P\right)dP}=\frac{a}{rA}>0,$$

$$\frac{\partial e^*}{\partial C_b}=\frac{1-a}{r\int_{r\left(1+e^*\right)}^{W} f\left(P\right)dP}=\frac{1-a}{rA}<0$$

$\partial e^*/\partial C_l>0$, and $\partial e^*/\partial C_b<0$ implies that the optimum interest rate is an increasing function of the transaction cost of the lender, and is a decreasing function of the transaction cost of the borrower. In the Internet financial market, both the lender and borrower enjoy certain bargaining power ($0<a<1$). Where the transaction cost of the borrower is excessive high, the borrower will take advantage of its bargaining position to lower the loan interest rate, and transfer part of the cost to the lender; similarly, the loan interest rate can be increased to transfer part of the cost to the borrower. Therefore, there is a positive correlation between the Internet financial interest rate and the transaction cost of the lender, and a negative correlation with the transaction cost of the borrower.

Proposition IV. There may not be a positive correlation between the Internet financial interest rate and the bank interest rate S of the same period.

Demonstration: In expression (6) under the first order optimum conditions, the function of $e^*\left(s\right)$ is defined. Take the derivative with respect to s in expression (6), then:

$$\frac{\partial e^*}{\partial s} = \frac{a-(1-r)}{r\int_{r(1+e^*)}^{W} f(P)dP} = \frac{a-(1-r)}{rA}$$

Where $a > 1-r$, $\partial e^*/\partial s > 0$, the bargaining power of the borrower is higher. If the loan ratio is high, the Internet financial interest rate is positively correlated to the bank interest rate S of the same period. For instance, if the bank interest rate S of the same period declines, the overall capital environment is loose. The borrower is likely to demand the lender to reduce the interest rate by virtue of its relative strong bargaining power; if the bank interest rate S of the same period grows, the overall capital environment is tense, and the loan ratio of the borrower itself is higher, the borrower is still likely to accept the higher interest rate posed by the lender even if it enjoys a relative strong bargaining power.

Where $a < 1-r$, $\partial e^*/\partial s < 0$, the ratio of self-owned capital of the borrower is high, the bargaining power of it is lower, the Internet financial interest rate is negatively correlated to the bank interest rate S of the same period. For example, in cases that the bank interest rate S of the same period declines, the capital demander with low risk and low interest rate in the Internet financial market turns to the formal financial market, while the capital demander with high risk and high interest rate remains in the Internet financial market. To achieve the expected profits, the capital suppliers with high bargaining power in the Internet financial market increase the interest rates, and the Internet financial interest rates will be on the rise conversely; in cases that interest rate S of the same period increases, the formal financial market pushes out some capital demanders with high security, and they turns to informal financial market, which demands the Internet financial market to lower the interest rates. Meanwhile, the original formal financial capital which is supposed to be loaned to the capital demanders with low interest rates is ready to be loaned to capital demanders in the Internet finance who are willing to pay higher interest rates, and they will flow to the formal financial market. Subsequently, the capital suppliers in the Internet financial market are forced to lower the interest rates, while the lower risk in the Internet financial market makes the capital suppliers in the Internet financial market willing to reduce the interest rates. The interest rates in Wenzhou private lending drops rather than grows when the bank interest rates are raised slightly (Wang Yiming, Li Minbo, 2005), which is an excellent example of the above theories.

Proposition V. No certain correlation relationship exits between the Internet financial interest rates and the loan ratios.

Demonstration: take the derivative with respect to r in the function relationship of $e^*(r)$ in expression (6), then:

$$\frac{\partial e^*}{\partial r} = -\frac{(1+s)-(1+e^*)\int_{r(1+e^*)}^{W} f(P)dP}{-r\int_{r(1+e^*)}^{W} f(P)dP} = \frac{(1+s)-A(1+e^*)}{rA}$$

Apparently, where $e^* < \frac{1+s}{A} - 1 = e_0$, the interest rate is positively correlated to the loan ratio; where $e^* > \frac{1+s}{A} - 1 = e_0$, the interest rate is negatively correlated to the loan ratio;

In the Internet financial market, the lender will increase the interest rate with the increasing of the loan ratio. Borrowers are still willing to accept the higher interest rate as long as it is no higher than its opportunity cost for the financing. Where the loan interest rate equal to the opportunity cost for the financing of the borrower, in other words, $e^* = e_0$, the loan ratio reaches its highest value r_0. In cases that e^* is relatively high, i.e., $e^* > e_0$, the loan cost of the borrower is relatively high, which will force the borrower to seek to other financing channels to collect capitals for investment (including cutting down expenditures and other project investment). As a result, the loan ratio in the Internet financial market will be lowered. There will be a negatively correlation relationship between the interest rate and the loan ratio.

Proposition VI. The higher the bargaining power of the borrower is, the lower the interest rate is; The higher the bargaining power of the lender is, the higher the interest rate is;

Demonstration: take the derivative with respect to a in $e^*(a)$ in expression (5), then:

$$\frac{\partial e^*}{\partial a} = -\frac{(\overline{P} - B_b - B_l)}{r\int_{r(1+e^*)}^{W} f(P)dP} \le 0$$

Due to $U_b(e) - B_b \ge 0$, $U_l(e) - B_l \ge 0$, then $\overline{P} - B_b - B_l \ge 0$

And $\partial a/\partial n < 0$, $\partial a/\partial m > 0$, $\partial a/\partial t < 0$, $\partial a/\partial u < 0$, $\partial a/\partial f > 0$, $\partial a/\partial v < 0$

Therefore: $\partial e^*/\partial n \ge 0$, $\partial e^*/\partial m \le 0$, $\partial e^*/\partial t \ge 0$, $\partial e^*/\partial u \ge 0$, $\partial e^*/\partial f \le 0$, $\partial e^*/\partial v \ge 0$

$\partial e^*/\partial a \le 0$, implies that the interest rate is a decreasing function of the bargaining power of the borrower. In other words, the higher the bargaining power of the borrower is, the lower the loan interest rate is. If $\partial e^*/\partial a \le 0$, then $\partial e^*/\partial(1-a) \ge 0$, which implies the interest rate is an increasing function of the bargaining power of the lender. That is to say, the higher the bargaining power of the lender is, the higher the lending interest rate is.

The bargaining power the borrower can be further broken down as follows:

$\partial e^* / \partial t \geq 0$ implies that the longer the loan period is, the higher the interest rate demanded by the lender is. The extension of the lending period means higher default risk for the borrower, and the lender is likely to miss better investment opportunities.

$\partial e^* / \partial t \geq 0$ means that higher interest rates are often necessary for urgent loans. For urgent capital demand, it is impossible for the borrower to find more lenders and the time limit will not allow the borrower to plan several bargaining. Meanwhile, additional costs are often imposed on the lenders to collect capital in a short period, thus the interest rates for urgent loans are usually higher.

$\partial e^* / \partial f \leq 0$ implies that the higher the operation capacity of the borrower is, the lower the loan interest rate is. Borrowers with high operation capacity are often featured by higher risk control capacity and problem solving capability, which increases their success probability for loans, and drives the loan interest rate lower.

$\partial e^* / \partial n \geq 0$, and $\partial e^* / \partial m \leq 0$ means that the loan interest rate is positively correlated to the number of the borrowers and is negatively correlated to the number of the lenders. In other words, the higher the competition of the creditors is, the lower the interest rate is; the higher the competition of the debtor is, the higher the interest rate is.

$\partial e^* / \partial v \geq 0$ implies that the loan interest rate is likely to be high under conditions with high regime risks. Due to no supervision measures has been imposed by People's Bank of China, the default risk and transaction cost increase risk arising from regime defects still exist, and the lender may raise the lending interest rate to offset the risk. As a result, the regime risk is a significant factor affecting the Internet financial interest rate.

IV. CONCLUSION

The Internet finance discloses the credit information of the borrower and the loan program information to the lender. As a result, the uncertainty of the loan projects in themselves and the costs for the implementation of secured credit contracts, rather than the reverse selection and moral risks arising from information asymmetry, form the main issues faced by the Internet finance. They also constitute the decisive factors of the loan interest rate of the Internet finance.

According to the analysis in the article, the Internet financial interest rate is a function of the natural risk of the loan program, the expected rate of return of the program, the loan ratio, the transaction cost, the bank interest rate S of the same period, and the relative bargaining power of the borrower and the lender. Effects of these variants on the Internet financial interest rate are also illustrated. Both the natural risk function and bargaining power function are introduced in the article with multiple factors affecting the interest rate included into the analysis framework of the model so as to illustrate the following propositions:

(1) There is a positive correlation between the natural risk level of the loan program and the interest rate. (2) The expected rate of return of the program is positively correlated to the loan rate where the program risk declines; while the expected rate of return of the program is negatively correlated to the loan rate where the program risk increases. (3) There is a negative correlation between the interest rate and the transaction cost of the borrower, and a positive correlation with the transaction cost of the lender. (4) There may not be a positive correlation between the Internet financial interest rate and the bank interest rate S of the same period. (5) The interest rate is positively correlated to the loan ratio if the interest rate is low; while the interest rate is negatively correlated to the loan ratio if the interest rate is high; (6) The loan interest rate is negatively correlated to the competition extent of lenders, and is positively correlated to the competition extent of borrowers. (7) There is a positive correlation between the loan urgency, the loan period, the regime risk level and the interest rate.

To sum up, the interest rate risk is common in the whole financial industry which includes the Internet financial industry. The marketization of the Chinese financial system, and the acceleration of the interest rate liberalization pose a great challenge for the emerging Internet financial industry. As for now, the Internet finance has suffered no severe impact of the loan interest rate liberalization. However, the Internet financial enterprises will certainly face more competition and challenges after the deposit interest rate liberalization. The operation cost is the advantage of Internet financial enterprises. They also provide financial products with higher rates of return. The advantage of the rates of return will be weakened after the fully liberalization of the interest rates, which will result in loss of customers, increase in sensibility to the variations of interest rates, and amplification of the impact of the liberalization of the interest rates on the Internet financial industry.

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