Research on Innovative Strategies to Regulate Private Lending for Small & Medium Enterprises in China——Based on Analysis of Modeling of Adverse Selection & Game Theory

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Abstract

By studying current situation of private lending for SMEs(Small and medium enterprises) in China ,the paper takes advantage of Modeling of Adverse Selection to analyze that assessment of private financial institutes for average profits with investments of SMEs impacts interest rates of loan, which might cause high interest rates of private lending; through Game Theory of Nash equilibrium, supervising organizations enforce efficient regulations, then the SMEs legally run businesses and private financial institutes would legally lend money to SMEs , therefore illegal lending might be eliminated. Based on above, from the perspectives of private financial institutes 、 SMEs and Supervising organizations , the paper puts forward to a number of innovative strategies to regulate private lending for SMEs in China.

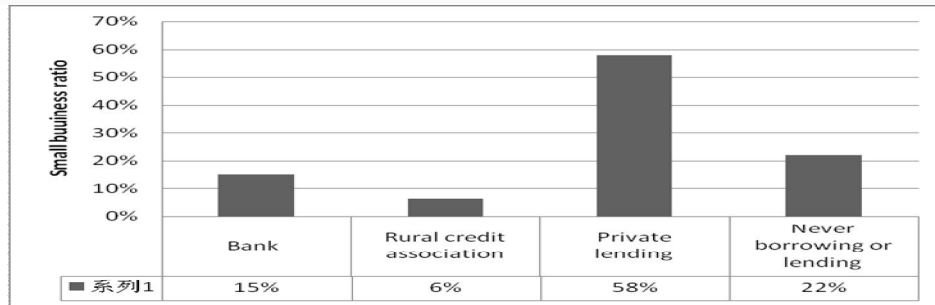**Keywords:** Private lending; SMEs; Adverse Selection; Game Theory

1. Introduction

According to the latest data show that China SMEs account for all enterprises accounted for more than 99%, Contribution to GDP over 60%,Contribution to tax revenue over 50%, and offer 80 percent of urban jobs and 82% of new product development. But of which only 1/3 companies to obtain funds from bank loans. [1]Therefore, now financing difficulties of SMEs in China has restricted the development of a major problem for SMEs , and SMEs obtain funds through bank loans is extremely limited. There are two main reasons: For one thing, SMEs information opacity and it's difficult to provide qualified mortgage; For another, SMEs in the capital demand has a "short" ,"frequent", " fast" feature, especially to our small and micro enterprises, which has resulted in higher bank lending additional costs. [2]Therefore, in order to meet the funding needs, SMEs will tend to seek other sources of financing, such as private loans, issue stocks and bonds, financial leases and so on . Nowadays, private lending has been from "underground" gradually transform into "surface", and showed a trend of specialization .Therefore ,it's very essential to regulate the development of private lending .

2. Present situation and problems of private lending for SMEs

First need to note is mentioned in this article refers to the broad private lending are private lending, including between citizens, between citizens and Corporate Legal Person, between citizens and other organizations lending, which includes loans from relatives and friends, private financial institutes (such as small loan companies, pawn store etc) loans and other means. But in the model analysis, in order to the convenience of analysis, General subject of private lending is specific between private financial institutes and SMEs. In addition, in this paper, the referenced data is take ZheJiang area of China as example , because its are more representative.

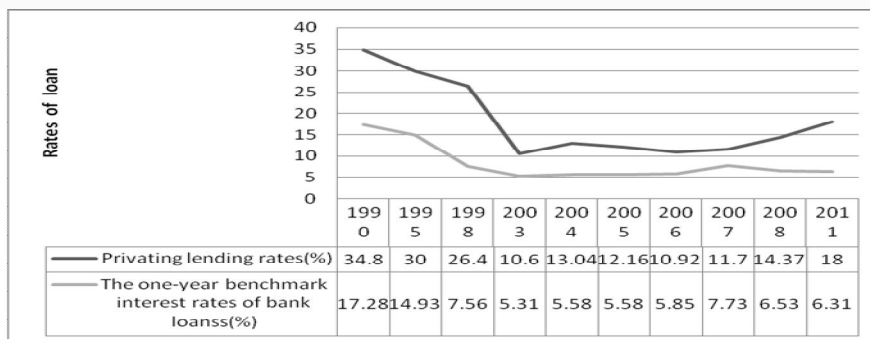### 2.1 Private lending is common and its proportion is large

Figure 1: The main channel of financing for surveyed small businesses in Zhejiang province[3]

As shown in figure 1, according to a study of Zhejiang, Alibaba and Development Research Institute of Beijing university, the study shows that in Zhejiang region, the folk lending share of small businesses reached 58% (including friends and relatives lending accounted for 29%, 21% share of the private lending, small loan companies and pawnbrokers accounted for 7% and 1% respectively), Select traditional Banks and rural credit cooperatives and other financial institutes as the main financing channels only 21%. In addition, more than 22% of small businesses never borrowing or lending with financial institutions or individual. Therefore, SMEs private lending in our country on the scale and proportion is large.

2.2 Private lending appear the phenomenon of high interest rates

Figure 2: Comparison chart of Wenzhou private lending and the Bank rate[5]

In general, the private lending capital cost is large and it's interest rates significantly higher than bank loan interest rates. But SMEs itself often have limitations, such as lack of endogenous financing, not reached bank credit rationing to SMEs, the capital market for SMEs discrimination.[4] Therefore , in order to development, SMEs financing will have to find other channels, such as private borrowing. Our law formulate the folk lending interest rates may be higher than bank interest rates, but similar loans shall not exceed the highest interest rates four times. the part of beyond interest will not be protected. As shown in figure 2, since 1990 to 2011, WenZhou private lending interest rates significantly higher than bank loans interest rates, and the trends appear broaden in recent years.

2.3 Private lending lack standard, it's disputes frequently happen

Table 1: The cases from 2007 to 2010 in Hangzhou City, Binjiang District court [6]

Period	Civil and commercial cases	The private lending cases	Ratio	The amount of money involved (million)
2007	917	116	12.7	2925
2008	981	234	23.6	20939
2009	1191	381	32.0	22543
2010	1690	354	21.0	20978

As we can see from table 1, from 2007 to 2010, In Hangzhou city BinJiang district ,the number of private lending case increasing year by year, the amount is growing rapidly, And private lending cases accounted for the proportion of civil and commercial cases is bigger. Visible, our country private lending is illegal , whether it's performance in the case of quantity or in amount is very big.

In addition, since March 2011, some SMEs boss appear constantly "run boom" phenomenon, such as "glasses" king of Mr. Hu run events, which result from private financing of higher interest rates lead to enterprise capital chain interruption, this also reflected the mess of Private Lending for Small & Medium Enterprises in China.

3. Adverse selection and Game Theory based on private lending analysis

3.1 The analysis of Adverse Selection Model among bank , private financial institutes and SEMs

Generally ,Private financial institutes refers to a number of companies or organizations ,which can offer qualified collateral to banks, They lend low-interest loans from the bank ,then provide to SMEs which are refused from banks, including small loan companies, pawn shops, etc.（The following model assumptions and formulas refer to [7], [9]）

Model assumptions: (A) Enterprises have multiple consecutive investment projects, each investment project has only two kinds of results: success and failure， success gains is R , the probability of success is P ; failure gains is 0 , the probability of failure is $1-P$; (B) Assume that a given type of loan ,all investment projects have the same mean income T , and the lender know it. So, if $P(R)$ is the probability of success of a given project, then $P(R) \bullet R = T$.(C) Investment capital of each enterprise investment projects is one unit, and the companies haven't their own funds.（Enterprise has its own funds does not affect the derivation process and rank. The private lending financial institutes）(D) Secured loans are the only source of funds business, companies haven't other means of funding sources. There assumes that the bank loan interest rate is r .

3.1.1 The private financial institutes borrowing from the bank

Borrower are private financial institutions (they play the role of enterprise in the model assumptions), and lenders are banks. Assumes that the ratio of the collateral that private financial institutions provide and the principal is $m \ (m > 1+r)$ .The expected profit function of private financial institutes is:

$$\pi = P \bullet [R - (1+r) \bullet 1] - (1-P) \bullet m \bullet 1$$

When $\pi = 0$, the critical point returns is R_0 , if and only if $R > R_0$, the private financial institutes can apply for a loan investments. And because of $P(R) \bullet R = T$, there is a critical success probability P_0 , if and only if $P \leq P_0$, the private financial institutes can apply for a loan.

$$\begin{cases} P_0 \bullet [R_0 - (1+r)] - (1-P_0) \bullet m = 0 \\ \\ P_0 \bullet R_0 = T \end{cases} \implies \begin{cases} P_0 = \dfrac{T-m}{1-m+r} \\ \\ R_0 = \dfrac{(1-m+r) \bullet T}{T-m} \end{cases}$$

We assume probability density function of P in $[0,1]$ is $f(p)$, the distribution function is $F(p)$, the average probability of success when the private financial institutes apply for secured loans from banks is：

$$\overline{P} = \frac{\int_0^{p_0} p \bullet f(p)dp}{\int_0^{p_0} f(p)dp} = \frac{\int_0^{p_0} P \bullet f(p)dp}{F(p_0)}$$

$$\frac{\partial \overline{P}}{\partial m} = \frac{\partial \overline{P}}{\partial P_0} \bullet \frac{\partial P_0}{\partial m} = \frac{\partial P_0}{\partial m} \bullet \frac{P_0 f(P_0) \bullet F(P_0) - \int_0^{p_0} Pf(p)dp \bullet f(P_0)}{F^2(P_0)}$$

$$= \frac{\partial P_0}{\partial m} \bullet \frac{f(P_0)}{F^2(P_0)} \bullet \left[P_o \bullet F(P_0) - \int_0^{p_0} P \bullet f(p) \right] dp$$

$$\frac{\partial P_0}{\partial m} = \frac{T-1-r}{(1-m+r)^2} \qquad \frac{\partial \overline{P}}{\partial m} = \frac{T-1-r}{(1-m+r)^2} \bullet \frac{f(P_0)}{F^2(P_0)} \bullet \left[P_0 \bullet F(P_0) - \int_0^{p_0} P \bullet f(p)dp \right]$$

Because

$$\frac{f(P_0)}{F^2(P_0)} \bullet \left[P_0 F(P_0) - \int_0^{p_0} Pf(p)dp \right] > 0$$

The inequality can be proved using the functional monotonicity. And the average profit is $T > 1 + r$,

So $\dfrac{\partial \overline{P}}{\partial m} > 0$

Then $\overline{P}$ increase with the increase of m, in other words, the more valuable the collateral provided by private financial institutes and the ratio of collateral to principal is larger, then the greater the average probability of success of business investment and the more harmless from banks to bear the risk of the loans. This shows that collateral is a necessary condition to solve the enterprise information asymmetry. In the previous model, $0 < P_0 < 1$, so $m > T > 1 + r$. In this part, the bank almost no risk, and private financial institutes undertake the risk.

3.1.2 Private financial institutes lending to SMEs

The borrower are SMEs, the lenders are private financial institutes. Set the ratio of collateral provided by SMEs to the principal is n. Due to the SMEs are unable to provide the collateral what banks need, we can get $n < m$, if private financial institutes lending interest rate is g, we generally consider $g > r$. Based on the above assumptions and under the condition of the SMEs to provide collateral so that we can obtain expected profit function as follows:

$$\pi = P \bullet [R - (1 + g)] - (1 - P) \bullet n$$

When $\pi = 0$, the critical point returns to R_0, if and only if $R \geq R_0$, the private financial institutes can apply for a loan investments. And because $P(R) \bullet R = T$, there is a critical success probability P_0, if and only if $P \leq P_0$, the SMEs can apply for a loan.

In addition, we also can get the expected profits of private financial institutes:

$$\theta = P \times [(g - r) \times 1] - (1 - P) \times (m - n)$$

In conclusion $\begin{cases} P_0 \times R_0 = T \\ P_0 \times (R_0 - (1+g)) - (1-P) \times n = 0 \end{cases}$

so $\begin{cases} P_0 = \dfrac{T - n}{1 + g - n} \\ R_0 = \dfrac{(1 + g - n) \bullet T}{T - n} \end{cases}$

when probability density function of P in $[0,1]$ is $f(p)$, the distribution function is $F(p)$, the average probability of success of secured loans which the private financial institutions apply for is

$$\overline{P} = \dfrac{\int_0^{P_0} p \bullet f(p)dp}{\int_0^{P_0} f(p)dp} = \dfrac{\int_0^{P_0} P \bullet f(p)dp}{F(p_0)}$$

$$\dfrac{\partial \overline{P}}{\partial n} = \dfrac{\partial P_0}{\partial n} \bullet \dfrac{f(P_0)}{F^2(P_0)} \bullet \left[P_0 F(P_0) - \int_0^{P_0} P \bullet f(p)dp \right]$$

and $\dfrac{\partial P_0}{\partial n} = \dfrac{T - 1 - r}{(1 - n + r)^2}$

Similarly we can prove: $\dfrac{\partial \overline{P}}{\partial n} > 0$

This situation is similar to the previous conclusions, the higher the collateral value provided by the SMEs, the smaller the risk to the private finance. But now the problem is that SMEs cannot provide the full amount of the collateral, we often get $n < 1 + g$. At this time, only when the expected profits of private financial institutes is θ and $\theta > 0$. They will lend to SMEs, and the loan application of SMEs will be accepted.

Put $P_0 = T - n\big/1 + g - n$ plug in the expected profits of

private financial institutes, we can get

$$\theta = P_0 \bullet [(g-r)\bullet 1] - (1-P_0) \bullet (m-n) = T - n\big/1 + g - n \bullet (g-r) - 1 + g - T\big/1 + g - n$$

Because $n < 1 + g$, $g > r$, $T > n$,

then $T - n\big/1 + g - n \bullet (g-r) > 0$, $1 + g - n > 0$,

so we need to make $\theta > 0$.

In one case, when $1 + g - T < 0$, that is $T > 1 + g$, then $\theta > 0$. It means that the private financial institutes to judge the benefits of SMEs average T greater than the amount of loans with interest, namely the T value is relatively large·

In another case, When $1 + g - T > 0$, in order to ensure the $\theta > 0$,we should meet the $g > r + (m-n)(1+r-T)\big/T - m$.

Set $f = (m - n(1+r-T))\big/T - m$, then $\frac{\partial f}{\partial T} = \frac{1+r-m}{(T-m)^2}$. Because $1 + r < m$, so $\frac{\partial f}{\partial T} < 0$ .That is f increases with

T decrease .The smaller average income which from private financial institutes for SMEs proposed investment projects, the higher interest what private financial institutions set. Then the SME should pay much higher interest rates than bank interest rates, so the phenomenon of the private lending with high rate will appears. In a word, the judgment of average income T which made by the private financial institutes when they are planning proposed investment projects, has influence on loan interest rate setting. This indicates that there is a phenomenon of opaque and asymmetric information in the SMEs, the private financial institutes is difficult to hold their credit situation. This causes the adverse selection of private financial institutes and improvement of lending rate g .

3.2 The game analysis among Regulatory authority, private financial institution and SMEs

In this section, stakeholders include private financial institutions and SMEs, and regulatory authorities. Regulatory authorities here mainly refers to the regulation of SMEs .But this paper argues that the best situation in the development of private lending is SMEs can be managed in compliance, private financial institutions can lend reasonably.(The following model assumptions and formulas refer to [8], [9]) Model assumptions: (A)Participants: private financial institutions, SMEs and regulatory authorities;(B)Strategies from all parties in the Game: private financial institutions can choose loan or not, SMEs can choose compliance management and irregular management, regulators can choose regulatory and non-regulatory .(C)There is asymmetric information in the Game, the regulatory authorities have information advantage with respect to SMEs, they must pay the cost C if they implement supervision.(D)Assuming that once regulators implement supervision, they can certainly find whether there is any irregularities in SMEs .At this time if the SMEs management is compliance, interest paid by enterprises is $P \bullet g$ (where P is the amount of enterprise loans, g is loan interest which SMEs loan from private financial institutions), the bank's revenue is $P \bullet g$.

If irregular operation of SMEs was found in time, these enterprises will be fined， namely is F , so bank's revenue can be assured, that is $P \bullet g$.(E)Regulatory authorities without supervision can gain leisure benefits θ , but the SME has irregular operation while regulator without supervision , it will lead to indirect losses L .(F) Regulators without supervision and they cannot find whether there is any irregularities in the SMEs. Then if the SME management is compliance, interest paid by enterprises is $P \bullet g$, the bank's revenue is $P \bullet g$;If the SMEs are operated illegally and enterprises refuse to pay interest, then private financial institutions will lose interest P and principal $P \bullet g$. Based on the above assumptions, the following Game process is introduced:

3.2.1 The Game between the regulator and SMEs

Seeing the following payoff matrix, the first algebraic (or number) represents the benefits of regulators, the second algebraic (or numbers) represents the benefits of SMEs. This is a mixed strategy Nash equilibrium.

Table 2: The payoff matrix when private financial institutions lending

		SMEs	
		Compliance Management	Irregular Management
Regulators	Regulatory	$-C,-P\bullet r$	$-C+F,-P\bullet r-F$
	Non-regulatory	$\theta,-P\bullet r$	$\theta-L,0$

Set E as a probability of a compliance management for SMEs, then the probability of irregular management is $1-E$ .Regulatory supervision probability is S , no supervision probability is $1-S$ .Given E , then expected revenue of the regulatory and non-regulatory supervision are:

$$K(1,E)=-C\bullet E+(-C+F)\bullet(1-E)=-E\bullet F+(F-C), K(0,E)=\theta\bullet E+(\theta-L)(1-E)=E\bullet L+(\theta-L)$$

If $K(1,E)=K(0,E)$, then $E=1-\dfrac{C+\theta}{F+L}$

Similarly, If $K(1,S)=K(0,S)$, then $S=\dfrac{P\bullet r}{P\bullet r+F}$

So there is a equilibrium $\left(1-\dfrac{C+\theta}{F+L},\dfrac{P\bullet r}{p\bullet r+F}\right)$

Obviously, when F larger the larger E , it means that the greater punishment strength to irregular business enterprises, the more compliance the enterprise management is .And private financial institution's Loans and interests will be recovered more secure.

3.2.2 The Game between the private financial institution and SMEs

See the following payoff matrix, the first algebraic (or number) represents the benefits of SMEs, the second algebraic (or numbers) represents the benefits of private financial institutions.

Table 3: The payoff matrix when the regulator supervising

		Private financial institution	
		Lending	Not lending
SMEs	Compliance Management	$-P\bullet r,P\bullet r$	$0,0$
	Irregular Management	$-P\bullet r-F,P\bullet r$	$0,0$

If a system comes into force, it must be a Nash equilibrium. Obviously, the above table is a pure strategy Nash equilibrium, and the optimal equilibrium is (compliance management, lending).Means that under the system of regulator's supervision, private financial institutions are more willing to lend and the more compliance the enterprise management is. Through the above analysis, we can draw the following conclusions: Banking regulators must consider sharing of benefits among the private finance, regulatory authorities and SMEs .Only if intensify supervision, the SME management will become more compliance, the private financial institution's lending will become more reasonable.

4. Innovation and regulatory policy of private lending

Through the analysis of the adverse selection and the Game theory model, this paper mainly illustrates two issues: First is the phenomenon of high rates of private lending, the second is the phenomenon of illegal of private lending. The model shows that compliance management of SMEs and reasonable lending of private financial institutions are the best situation in the process of private lending's development. To solve the above problems, this paper puts forward some innovative strategies from private financial institutions, SMEs, regulators three angles to regulate private lending.

4.1 The perspective of private financial institutes

The judgment of average income T which made by the private financial institutions when they are planning proposed investment projects has an influence on the level of private lending interest rate g .This requires private financial institutions to grasp the enterprise's information accurately at first, such as enterprise's profit ability, debt paying ability, in order to avoid adverse selection caused by asymmetric information .In addition, private financial institutions should keep track of capital movement of SMEs after lending .

It can prevent enterprises from withdrawing funds, SMEs usually avoid a broken capital chain by keeping new lending coming in to pay for the due lending they borrowed before. .Only through these measures, private financial institutions can make accurate judgment when they are planning proposed investment projects .so they can decide whether to lend and the set of lending interest rate.

4.2 The perspective of SMEs

The transparency of SMEs information and credit standing directly affects the set of lending interest rates .Therefore, the SMEs want to get loans from private financial institutions, first of all they need to keep its information transparently, thus private financial institutions can more easily understand their actual situation and improve the efficiency of lending. Second, because of insufficient collateral, SMEs can't get loans. At this time the credit guarantee can make up for this defect. Therefore, SMEs should also strengthen the construction and improvement of the credit guarantee system and establish guarantee risk compensation mechanism, guarantee fund and re-guarantee fund system.

4.3 The perspective of SMEs

In reality, only when regulators intensify punishment, reasonable lending of private financial institution and compliance management of SMEs can be ensured .Regulators should strengthen supervision of private lending funds where they from and where they go .On the one hand, they should intensify the punishment of private financial institution's irregularities loans .On the other hand, they should verify the source and destination of lending funds to prevent SME's funds from being operated irregularly .In this way we can promote the compliance management of SMEs, reasonable lending of private financial institutions ,thus ensure the legalization of private lending

5. Conclusions

By the adverse selection model and Nash equilibrium game theory model, the paper analyzes the two most important problems the SMEs are facing, that are high interest rate of private lending and illegal private lending .The judgment of average income which is made by the private financial institutions when they are planning proposed investment projects has an influence on high interest rates. The lack of strong regulatory supervision is one of reasons of these illegal private lending .Therefore, innovative strategies which will be used for normalizing the development of private lending should also start from these two points .It needs joint efforts of the three parties, including private financial institutions, SMEs and regulators . we should construct a three sets of standard systems, in which, on the premise of SMEs strengthen themselves to obtain the trust of regulatory authorities and private financial institutions, at the same time ,a reasonable loan of the private financial institutions should act as the incentive, and the supervision of the regulatory authorities.

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