

Analysis on the Dynamic Game Model of SMEs Group Loans

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Abstract – Recent years, Group Lending has been superior to other financial products in solving lending problems for small and medium enterprises(SMEs), which attracts a few economists and policy makers' attention. They focus on the reasons why Group Lending can achieve so much success, but little attention is paid to the applicability of this method to solve lending problems in China. This paper analyses the model of dynamic games among the borrowing enterprises, guarantee enterprises and the banks. Finally, it puts forward some countermeasures to satisfy the requirements.

Keywords – Group Lending; Game Theory; SMEs

1. Introduction

Group loans, as a kind of microfinance, has just generated in recent decades. Several SMEs with difficulties in loan combine together to form joint grantors, than banks offer credit to these enterprises respectively. The loan can be obtained after certain joint margin is paid. The risk margin should be paid by the enterprises participating in the group are different according to their different credit balance. The cost of dishonesty is very high: If one enterprise cannot repay the loan on time, other member enterprises should liquidate jointly; if group debt is not fully repaid, all group members will never be able to obtain loans from the bank. Nowadays, many developing countries and developed countries such as United States and Canada

adopt this mode to offer loans.

One important reason of the high repayment rate is the joint liability among the members, which can provide a social guarantee and supervision. Members with successful investment will bear joint liability for the loser, thereby forming a kind of guarantee. When joint liability contract is signed, horizontal oversight will improve the borrower's expected return by reducing the default probability of the entire group. The maximum advantage of group loan is to achieve a risk-sharing and to reduce the risk of asymmetric information between banks and enterprises. The whole process of group loan forms a multi-party dynamic game since the interest goals pursued by borrower enterprises, guarantee enterprises and the bank are different.

2. Analysis of game among borrower enterprises, guarantee enterprises and banks

Under the condition of asymmetric information, the behaviors of banks and enterprises are asynchronous, any main body of the game does not know the type, the occurrence probability and influence of the opponent on itself. Thereby the game among them is dynamic under the state of incomplete information, and only can be preliminarily judged. The preliminary judgment can be corrected according to actions of other participants, and own strategy can be rationally selected. Assume that the possibility for the bank to offer loan to the enterprise is P in the first stage of the game between the two sides, if the banks do not offer loans, both sides are unable to gain; if the bank offers loan to the borrower enterprises, borrower enterprises have two strategies to choose -

repayment on time or default. At this point, the game of two sides enters the second stage. At this stage, if the borrower enterprises repay on time, the gains of banks and enterprises are respectively $(R_c = A_i, R' - A(1 + i))$; If the loan is not repaid, since the loan is offered in the mode of joint guarantee, the loan of the bank should be repaid by the guarantee enterprises instead, the bank's revenue remains $R_c = A_i$, the income of the borrower enterprises is $R' - A(1+i) + A - M - K$, and the income of the guarantee enterprises is $M + K - A(1+i)$. M refers to the improvement of social reputation, which is obtained by the guarantee enterprise after repaying for the loan enterprises, thereby bringing improvement in brand value and social influence. The game tree in the first and second stages are shown in Figure 1, two numbers in the brackets represent the bank's income and corporate income.

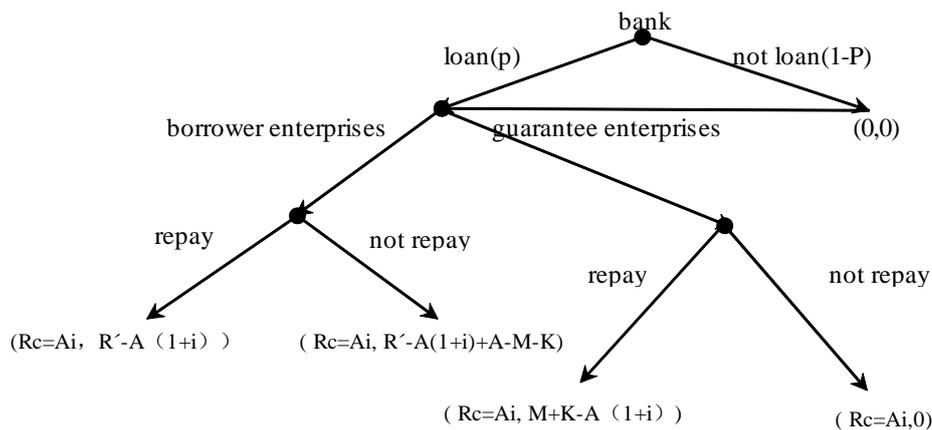


Figure1. Analysis of Games of All Parties in SMEs Joint Guarantee Group Loan

Now, we assume that the credit behavior between banks and enterprises is only conducted once, if the borrower enterprises repay the loan on time, corporate income is $P[R' - A(1+i)]$; if the borrower enterprises do not repay the loan, the income is $P[R' - A(1+i) + A - M - K]$. Here, it is obvious that $P[R' - A(1+i)] > P[R' - A(1+i) + A - M - K]$. Since the game between both sides is only conducted once, rational borrower enterprises must select breach behavior inevitably. From the bank's point of view, since the joint liability of the guarantee enterprise is regulated in advance, he can get back repayment principal and interest from the guarantee enterprises, the bank suffers no loss, which strengthens the loan behavior of banks. In this case, the balanced result of the game is as follows:

the borrower enterprises obtain loans and breach the contract, the bank obtains principal and interest from the guarantee enterprises, the lost amount of the guarantee enterprises is the balance between the principle-interest of the loan and the joint guarantee margin, but certain credibility as well as the convenience of future transactions with the bank can be obtained, the guarantee enterprises can implement the right of subrogation in certain future period, and can get back the principal and interest from the borrower enterprises. Although the banks do not suffer in one game, guarantee enterprises are rational, they can select "trigger strategy" after weighing integrity income and material damage, namely, after the opponent party breaches the contract, they also select betrayal and never cooperation. So, the bank

becomes the largest material loser, and can only get joint guarantee margin K at most, the borrower enterprises can not obtain further loan from the bank due to credit blemishes, the credit of the guarantee enterprises naturally can be affected to some degree, the tripartite cooperation is ended. Obviously, this is not the best game equilibrium point because if the three parties

continue to cooperate, they will receive greater benefits. Suppose that both lenders and borrowers are expected to have the probability of p to continue the transactions before the first game, and assume that the same result can be obtained in each game, the banks take the "trigger strategy", at this point, the game among three parties is shown in Figure 2.

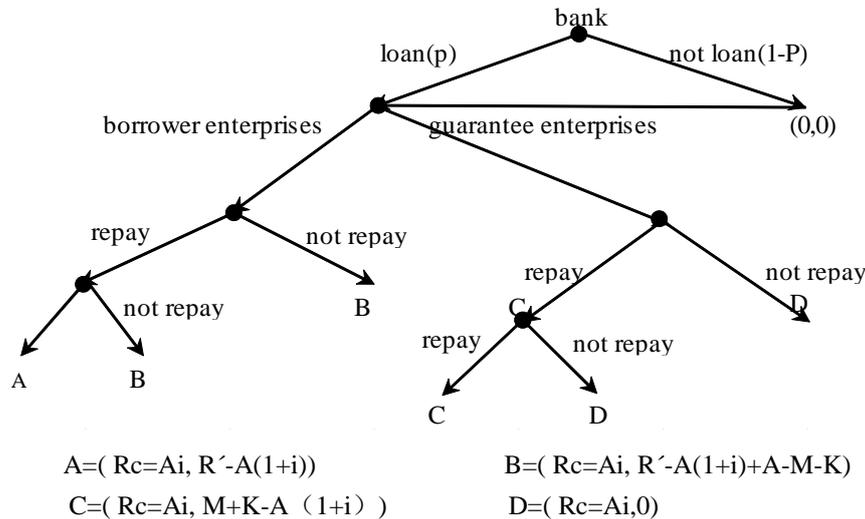


Figure 2. Analysis of Games of All Parties in SMEs Joint Guarantee Group Loan

Then, which kinds of coping strategies will the borrower enterprises take? If the borrower enterprise chooses not to repay, then current income that it gets is $P[R'-A(1+i)+A-M-K]$, since the income of each period is 0 in the future, its total income is $P[R'-A(1+i)+A-M-K]$; if the enterprises repay on time, its income in the current period is $P[R'-A(1+i)]$, we assume that the enterprises repay in time in the last period, the possibility of obtaining loan in the next period is ξ , and the income is $\xi n[R'-A(1+i)]$. Therefore, if the enterprises maintain compliance with these covenants and repay on time, the eventually obtained discounted total revenue is as follows:

$$P[R'-A(1+i)]+P\xi[R'-A(1+i)]+P\xi^2[R'-A(1+i)]+\dots+P\xi^n[R'-A(1+i)]=P[R'-A(1+i)]/1-\xi$$
, when $P[R'-A(1+i)]/1-\xi \geq P[R'-A(1+i)+A-M-K]$, the loan enterprises should select repayment strategy on time as the best strategy, the follows can be finally obtained: $\xi \geq (A-M-K) / (R'-A(1+i)-M-K)$. Suppose $\xi \geq 50\%$, namely, if the loan enterprise repays on schedule, the possibility for it to obtain loan will be greater, then, $(2-i)A-M-K \geq R'$ can be finally educed, the meaning of the inequality is that the difference among the income obtained from the

production business investment activity by the enterprise through utilizing the continuous loan from the group loan, reputation loss caused during beach of the contract (M), and the pre-paid joint guarantee margin (K) is greater than the operating or investment income of single loan, the enterprises select repayment in time, and trustworthiness is the best choice of the enterprises. Therefore, under China's unique institutional environment and cultural traditions at present, interest rates, penalties, discount rate, deposits will affect the enthusiasm of repayment from group loan enterprises, but the effect strength of these factors is determined by the role of the reputation. If smooth information is maintained, enterprises are rooted in a cluster or park, the reputation impact will be significant, rational borrower enterprises will choose to compliance with the contract as a balanced strategy for long-term development.

3. Conclusions and measures

It can be seen from the game analysis that: the borrower enterprises, guarantees enterprises and banks form a dynamic game process due to information asymmetry, in accordance with the assumptions of the

rational man, the three sides analyze cost efficiency according to own mastered information and actions of others, thereby rationally selecting own strategy. The difference between income obtained by the loan enterprises from production business or investment activity through comparison continuity and the loss brought during breach of contract, and the income obtained from single loan are adopted for determining whether the loans should be repaid in time or not, if the former is greater than the later, the loan enterprises can keep faith and repay in time, otherwise the enterprises can breach the contract. Guarantee enterprises also can analyze the cost-benefit when the loan enterprises breach the contract, thereby weighing integrity income and material losses and making the decision in accordance with own maximum interests; the income of the banks is stable under the condition that any one of the borrower enterprises or guarantee enterprises does not breach the contract. The bank is the maximum loser in the whole game process under the condition that both the borrower enterprises and the guarantee enterprises breach the contract, the banks only can obtain the pitiful margin far less than the principle and interests. Meanwhile, it also can be seen that the SMEs form a joint guarantee group on the basis of interest interoperability in the whole course of the game, which is the prerequisite, improved banking supervision functions and dynamic incentives are the guarantee basis for repeating the game among three parties, thereby we can start from the following aspects in order to guarantee sufficient role of the game mechanism among borrower enterprises, guarantee enterprises and banks.

3.1 Establish bank monitoring mechanism to prevent group loan risk.

The offer, repayment and management responsibility of the credit personnel should be strengthened, post-loan monitoring and risk prediction operations should be done well. The bank can take the form of "two -group loan", except the member enterprises which form joint guarantee group, the bank's internal loan officers also should form a team for the loan audit, horizontal oversight and joint liability among the loan officers should be utilized to strengthen incentives . In addition, banks also should establish a system of risk

compensation, local governments can invest risk compensation funds from the annual financial budget to build a greater risk firewall to encourage cooperation between banks and enterprises, commercial insurance can also participate in a timely manner to share the risk of loans.

3.2 Enhance dynamic incentives to promote the repeated operation of the game mechanism

The group loan game mechanism can be repeatedly operated with the condition that after joint guarantee member enterprises confirm to repay on time, they also can obtain new loan, obtain higher amount of the loan and obtain the loan with interests lower than the former loan when they need further loans. In order to repeat the game between enterprises and banks, the bank should strengthen the timely repayment incentives, the advantages of keeping path should be declared to the members of group loan when the loan is offered initially. The bank should promise to the enterprises that if the enterprises form group loan alliance, the obtain loan can be used according to prior contract requirement, the enterprises can apply for loan again if the enterprises repay the interest and principal, they can obtain preferential treatment on the loan amount and interest rate, and the level of concessions depends on its trustworthiness degree. At the same time, banks can encourage the loan alliance members to disclose the risk behavior of other members, and the joint liability of the enterprises can be lowered.

3.3 Enhance mutual understanding and trust among the loan members and strengthen interest synergy

It is the key for smoothly extending the game mode to strengthen the interest synergies among members in the group, and to increase the game number between the enterprises and banks. Government and industry associations must play an active role in advocacy as well as guidance of group loan model. The government should strive to improve the credit financing environment, advocate group loans, severely punish cheat loan enterprises and govern information distortion. Meanwhile, industry associations or government should

take the lead, the joint guarantee group should organize and implement comprehensive survey of enterprises, thereby understanding the business situation and capital requirements of enterprises, matchmaking the establishment of joint guarantee relationship among enterprises, and providing enterprise information for the bank. Joint guarantee group should be established, the industry associations should be entrusted for coordination, the enterprises should propose joint guarantee application to the industry association, industry associations or Small Business Administration should take the lead to form the joint guarantee group which is responsible for examining and approving the compliance of the joint guarantee group member composition, and checking the highest loan limit of the group. The three parties should develop the implementation details of the group loan, establish and manage joint guarantee file group loan, thereby becoming the bridge among the joint

guarantee enterprises, and between the enterprises and the banks.

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