

Credit Game Study between the Bank and the Enterprise in China

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Abstract—There exist both cooperation and competition between commercial banks and enterprises regarding to credit transactions. How to achieve mutual benefits and reduce credit risk has always been a major issue for China's banking industry. This paper establishes a credit game model between the bank and the enterprise, trying to find out the root cause of credit risk and possible ways to improve the situation. The result shows that the information delivery in the market plays an important role in each player's behavioral options and that the information asymmetry may lead to the agreement failure on credit loans and increase credit risk. With heavier punishment of dishonest behavior and repeated games, enterprises tend to be honest to obtain long-term benefits. At the end of the paper, a series of measures such as increasing punishment cost, creating a sound credit system, etc are suggested to avoid the adverse selection and reduce the moral risk.

Keywords—credit risk; credit game; information asymmetry; payoff

1. Introduction

Information asymmetry is a primary factor that generates the credit risk of commercial banks. Commercial bank and enterprise are the main subjects involved in credit fund movement. Enterprise is the user of the fund, who is in a position of information superiority as he knows more about the actual investment projects of borrowed money. If commercial bank fails to grasp the information timely, accurately and comprehensively, there may be decision-making errors which would lead to credit loss and increasing non-performing asset. Regarding to the problem, although China has introduced a series of financial rules and regulatory measures to regulate the behavior of banks and enterprise, the effect is not that obvious. According to the China Banking Regulatory Commission 2011 Annual Report, by the end of 2011, China's commercial banks' non-performing loan balance was ¥1.05 trillion and non-performing loan ratio fell to 1.77 percent. Our banking assets quality and ability to resist risk were further enhanced. However, when compared with western countries, our commercial bank's risk degree is still pretty grim. This can no longer be simply categorized as historical problems, and we have to take a deeper rethink of its root cause.

2. Credit game model under information asymmetry

Corporate sources of funding include the exogenous and endogenous financing. Exogenous financing generally contains equity financing and debt financing, while debt financing includes the bank loans and bond

financing. The majority of our small and medium-sized enterprises are non-listed companies and cannot issue corporate bonds, bank credit then naturally become the main source of financing of these enterprises. The bank's goal is to maximize capital gains in a given business risk conditions while corporate goal is to maximize profits under a given cost constraints. Enterprise capital strength and management level play a important role in bank's decision-making. However, due to market imperfections, information for decision-making cannot be effectively delivered in the credit markets. The bank is difficult to obtain real business information or have to pay costly for the information, while enterprise has a comprehensive understanding of their own operating conditions and can extract information rent from the bank.

We assume that there are two kinds of fund-raising enterprise in the market. They are C (credible) which is in good operation performance and capable of repaying loans and I (incredible) which is in poor operation conditions and unable to afford the repayment. In reality, the bank cannot determine whether the financing enterprises are Class C or Class I, they can only rely on enterprises' past operating records and the application reports. If the probability of a fund-raising enterprise judged as C is μ ($0 < \mu < 1$), then the probability of being judged as I is $1-\mu$. From the enterprise point of view, they have two financing strategies: endogenous financing and bank credit financing. The cost of bank financing is relatively low compared with endogenous financing in urgent need for funds. Enterprise cannot benefit from endogenous financing, thus we define the payoff is 0. If enterprise chooses bank credit financing and does get bank approval, the payoff is YC ($YC > 0$). But if enterprise fails to get bank approval and bank judge it as class I, it will have adverse effect on enterprise's future

operation performance, thus the payoff - YC^* ($YC^* > 0$). From the bank point of view, they also have two strategies: to grant loans or not. If the bank regard the fund-raising enterprise as class C, the payoff of granting loans and not granting is YB ($YB > 0$) and $-yB$ ($yB > 0$)

respectively. That's because bank would have opportunity cost if he doesn't grant loans to C enterprises. If the bank regard the fund-raising enterprise as class I, the payoff is $-YB^*$ ($YB^* > 0$) and 0 for granting loans and not granting respectively.

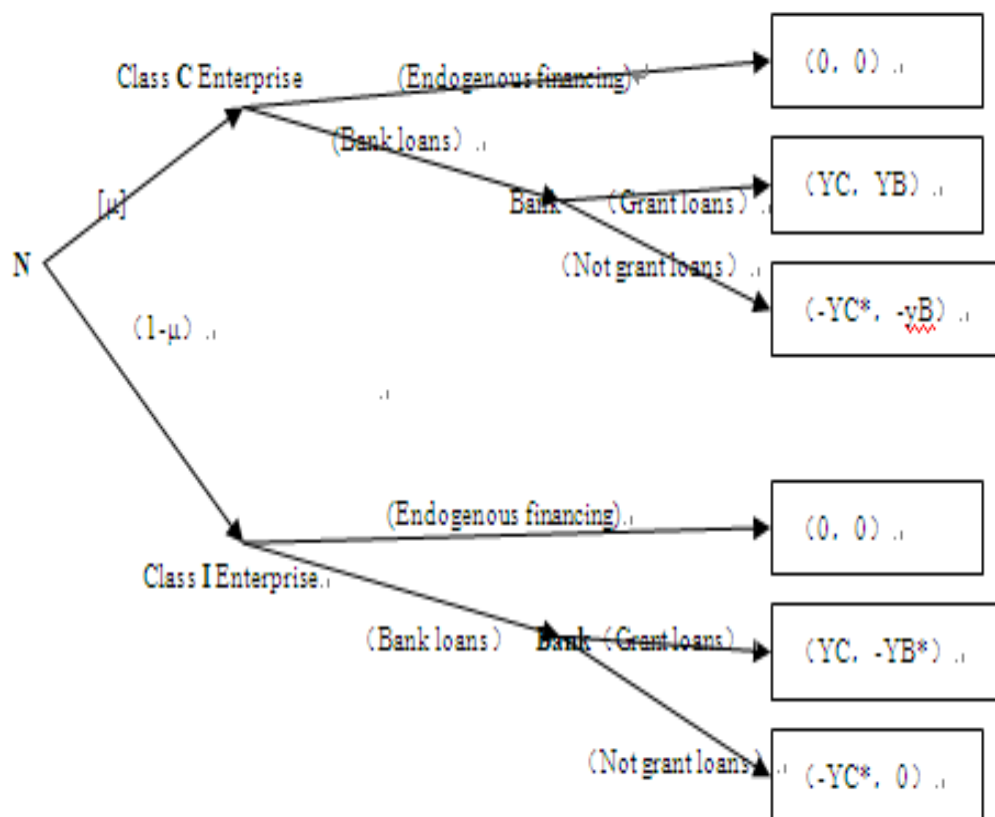


Figure 1.0 Bank-enterprise credit game tree under information asymmetry

As can be seen from figure 1, we have introduced a pseudo-player – N (nature). N determines the type of player and then enterprise and bank make decisions respectively. But due to incomplete information, bank cannot determine its decision node as it is covered by information set. His final strategy depends on expected payoff of granting loans ($\mu \times YB + (1 - \mu) \times (-YB^*)$) and that of not granting loans ($\mu \times (-yB)$).

We can work out the two perfect Bayesian equilibria:

- (1) When $\mu > (YB^* - yB) / (YB + YB^* - yB)$, the bank will choose to grant loans. Enterprise is in information dominant, knowing the bank has obtained that information and will choose to grant loan, then the optimal strategy for enterprise is to seek bank loans. Thus there is the only perfect Bayesian equilibrium (YC, YB) ;
- (2) When $\mu < (YB^* - yB) / (YB + YB^* - yB)$, the bank will not choose to grant loans. Likewise, enterprise is in information dominant, knowing the bank will not choose to grant loan, then the optimal strategy for enterprise is to select endogenous financing. Thus there is the only perfect Bayesian equilibrium $(0, 0)$;
- (3) When $\mu = (YB^* - yB) / (YB + YB^* - yB)$, both the above two equilibria exist.

But due to incomplete information, bank has the probability of $(1 - \mu)$ to grant loans to class I enterprise in one-time game, which means there may exist an unstable equilibrium $(YC, -YB^*)$. The credit risk exists, and it has an anti-correlation with μ . This results from information asymmetry between the bank and enterprise. If information is symmetric, $\mu = 1$ or 0 , we then could ruled out the unstable equilibrium $(YC, -YB^*)$. Therefore, we could make μ tend to be 1 or 0 through repeated games, and thus eliminate the credit risk in the case of information asymmetry.

In China, incomplete information prevails in the credit market. The information banks can obtain only reflects part of the past or known to the public. It cannot fully reflect the public and the undisclosed, historic and the realistic corporate information. In other words, it is just a semi-strong efficient market and fails to achieve Pareto efficiency of credit fund allocation. Meanwhile, information noise and information transfer barriers can be easily found in credit market, further exacerbating information asymmetry. The irrational credit market resulting from information asymmetry not only makes the bank reluctant to lend and undermine market efficiency, but also greatly weaken the bank's ability to analyze, identify and deal with information and distorts information transmission mechanism. It is difficult for

the credit market to recover from the non-equilibrium, which not only affects the normal operation of the credit markets, but also increases the risk of bank credit. Apart from that, due to the fact that banks fail to know the real profitability and operational risk, they determine the loan interest rate only based on the average profitability and risk. Under this circumstance, robust enterprise will withdraw from the lending market because of high cost, while high-risk enterprise may be willing to pay high interest rates. The result is actually tantamount to encouraging the flow of credit funds to low credit, resulting in the massive accumulation of non-performing assets of banks in our country.

3. Opportunity cost of dishonest enterprise and repeated game study

3.1. Opportunity cost of dishonest enterprise

Opportunity cost of dishonest enterprise means the benefit the enterprise would gain if it chose to be honest. When the enterprise gets the grant, he may use fund in high-risk project, contrary to the agreement with bank, which may impose potential loss. The loss may come from the punishment by regulators or laws, economic loss as other enterprises or banks no longer cooperate with it, or the loss of reputation, etc. In summary, the benefit enterprise loses includes direct economic benefit and reputation effectiveness.

We assume that both the benefit and effectiveness can be quantified to some extent. Under the premise that bank chooses to grant loans, if the enterprise choose to be honest, which means it will comply with the agreement for fund use, the payoff is 11 when the behavior is found by banks or regulators or the payoff will be 10 when the behavior is not discovered. The former payoff is higher. That's because the enterprise will benefit from its honest behavior in the future, and now we discount the benefit to current payoff. If the enterprise chooses to be dishonest, which meat it uses the fund in high-risk items without bank's permission, the payoff is Z when the behavior is found by banks or regulators or the payoff will be 12 when the behavior is not discovered. As the real purpose of the fund cannot always be discovered, we assume the probability of being discovered is μ and that of not being discovered is $1-\mu$. We then could come to payoff matrix as following:

Under the circumstances, the expected payoff under honest behavior is $11*\mu + 10*(1-\mu) = 10 + \mu$, while the dishonest payoff is $Z*\mu + 12*(1-\mu) = 12 + (Z-12)*\mu$. When $10 + \mu > 12 + (Z-12)*\mu$, that is $\mu > 2/(1+Z-12)$, the enterprise will be honest while the reverse is the case. As can be seen from the formula, the easier enterprise's behavior is discovered by banks or regulators (the bigger μ is), the more honest the enterprise will be. Likewise, the heavier the punishment is (the bigger Z is), the more honest the enterprise will be. When the probability of being discovered is established, the most effective way to reduce credit risk is to increase punishment cost.

3.2. The effect of repeated games on enterprise and banks' strategy

With high degree of specialization in modern market economy, each player must carry on multiple transactions, even with a fixed object in many cases. This means repeated games are conducted among players. In bank-enterprise game, each game must be based on mutual trust and integrity. If the enterprise wants to deceive bank, it can account for one cheap only. As can be seen form table 1, the enterprise can get a payoff of 12 if its dishonesty isn't discovered, a payoff of 2 more than being honest. But if its behavior is discovered, it will bring long-term losses. In general, as long as the short-term benefit is less than long-term loss, the enterprise will not be dishonest. Instead, they will establish their own reputation in repeated games so as to get higher long-term gains.

Table 1.0 Payoff matrix of fund-raising enterprise

| Fund-raising enterprise \ Bank & Regulator | Foun d | Not found |
|-----------------------------------------------|-----------|--------------|
| | d | found |
| Honest | 11 | 10 |
| Dishonest | Z | 12 |

In one-time, if one party breaks promises, the other party cannot revenge it by the retaliation strategy of "TIT for TAT". In repeated games, each player can constantly adjusts their trading strategy through observing opponent's behavior and builds their reputation of integrity. If two players want to cooperate, each one would like the other to believe their sincerity and establish mutual trust. Only in repeated games, revenge and reputation building will be possible. The reason why each player tends to choose "integrity" strategy is because they want to get long-term benefits. Any dishonesty will result in co-operation interruption and this is also one of the opportunity cost. Therefore, only cooperation based on repeated games and mutual trust can last long.

4. Suggestions and recommendations to reduce bank-enterprise credit risk

4.1. To create a sound credit system through repeated games

As is analyzed above, if we establish a sound credit system, in which each enterprise has a credit profile and the profile is open to the public, it'll help reduce the cost of access to information and each player in the market will have relatively complete information, most importantly, it serves to make one-time into repeated games. Thus in the case of the same given external market conditions, enterprise of poor operating performance would fail to get grants from the bank or get grants that match its risk, the credit risk of bank credit will be naturally reduced.

4.2. To strengthen supervision and increase the cost of dishonesty

Regulatory departments should further strengthen supervision and control of enterprise financing process and bank lending process, and improve the extent of punishment of illegal operation, fraud, breach of contract, etc. As long as the payoff of honesty is greater than that of dishonesty, player will choose integrity. Moreover, the improvement of financial laws and regulations also serve to provide legal basis for the effective running of credit system.

4.3. To improve bank's internal risk control

The "red point" has now become a credit culture of the Chinese banking sector. In order to complete some assessment indicators or the scale of loan task, some banks or bank employees may relax credit review and only focus on amount increase. Therefore, only improving bank's internal risk control and credit review by establishing a sound internal control mechanism can we guarantee that the bank loans are rational and the credit risk is under control.

4.4. To build awareness of corporate integrity

The awareness of corporate integrity is the foundation of credit market and the most effective spontaneous constraints which is closely related to credit risk. If enterprise consciously takes trustworthy strategy, the bank will consciously adopt a cooperative strategy. This is some kind of integrity, the soft constraints of credit risk between banks and enterprises. Although the awareness building of corporate integrity is a long-term process, it can never be ignored.

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Vitae



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