

Game Theory Analysis of Commercial Banks and Micro-Enterprises Credit in Post - epidemic Era

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Abstract. Micro-Enterprises are an important component of the economy and have made significant contributions to economic development. Especially in the post-epidemic period, the need for national economic growth and the importance of micro-enterprise development is gradually prominent. Micro-Enterprises still face the problem of “financing difficulty”, unable to get enough bank loans. In this paper, from the perspective of game theory, the incomplete information static game between micro-enterprises and commercial banks will be constructed. This paper mainly discusses the pre-loan investigation of commercial banks for micro-enterprises and provides some suggestions for the financing difficulty of micro-enterprises.

Keywords: Commercial Bank; Micro-Enterprise; Loaning Survey; Game Theory.

1. Introduction

1.1 Research on the Background

During the epidemic period, domestic micro-sized enterprises collapsed due to business difficulties is familiar. During the post-epidemic period, China’s economy recovered steadily, and enterprises’ reproduction increased. However, the recovery of micro-enterprises was relatively lagging, and the problem of financing difficulties for micro-enterprises was also becoming increasingly prominent. At present, micro-enterprises have been involved in agriculture, forestry, animal husbandry, fisheries, mining, manufacturing, education, health, social security, catering, culture, entertainment and other twenty industries in China. They are almost covering all industries except the public facilities management industry. Therefore, promoting the development of micro-enterprises plays a key role in economic system reform, improving economic structure, expanding social employment and maintaining social stability [1].

To help solve the problem of financing difficulties of micro-enterprises, the state has issued many supporting policies, including tax relief, fiscal expenditure, financing support and so on. However, the main source of financing for micro-enterprises is commercial bank credit loans. Commercial banks generally have low lending rates for micro-enterprises. The core reason for this phenomenon is the information asymmetry between both sides. In the early investigation process of commercial banks’ lending to micro-enterprises, enterprises may disclose false information to banks to obtain loans, and banks will also investigate the real situation of micro-enterprises before lending to determine whether to lend or not. If micro-enterprises use information fraud to deceive banks to obtain loans during the investigation period, it will increase the risk of bank lending and cause certain losses. Therefore, most commercial banks are worried that they cannot correctly know the actual operation state of enterprises due to information fraud of micro-enterprises. They choose not to lend to micro-enterprises, resulting in “financing difficulties” for micro-enterprises.

1.2 Literature Review

Many scholars have analyzed the credit problems of commercial banks and micro-enterprises from different perspectives, providing new processes for solving the financing difficulties of micro-enterprises. Given the analysis of credit loan mode, Luo Donghan (2018) analyzes the problems existing in the present credit loan mode of micro-enterprises by establishing a game model between borrowers and lenders, introduces the application of big data analysis under the scene of Internet-based finance and the credit rating standard of micro-enterprises to further study the model, and

provides a new idea to solve the financing difficulties of micro-enterprises. But because the current system level is not perfect, the data statistics are difficult, resulting in insufficient experimental credit verification [2]. In the study of the game behaviour between commercial banks and micro-enterprises in the process of credit, Zhang Jinwei (2013) constructs the incomplete information dynamic game model to provide a reference for the risk management of commercial banks in the process of developing micro-enterprises. The paper also emphasizes the importance of establishing an enterprise credit database [3]. Given the research on the risk proportion sharing of credit guarantee loans for micro-enterprises, Wang Miao (2017) constructed a two-party cooperative game model between commercial banks and guarantee institutions, and used the Shapley value method to solve it, thus providing theoretical and practical support for the development of credit guarantee financing system for micro-enterprises [4]. Given the research on the stage of micro-enterprises applying for loans and repayment of loans, Zhang Yu (2012) constructed the evolutionary game model of banks and enterprises from the perspectives of the risk of project failure of micro-enterprises and the rewards and punishments of bank supervision after loans and explored the evolutionary game strategy of banks and enterprises in the long-term credit game [5]. Given the research on the relationship between banks and enterprises, the institutional environment and the credit availability of small and medium-sized enterprises, He Ren, Liu Bingyong and Wang Jingjing (2012) took the enterprise survey data of 23 large and medium-sized cities in China as samples, this paper empirically studies the influence of the relationship characteristics of small-sized enterprises on the credit availability of enterprises under the background of institutional environment in different regions of China. It is concluded that the relationship lending technology of small-sized enterprises and commercial banks in China can play an important role only in a good institutional environment [6]. Based on the above literature for further analysis, this paper aims to use the game theory method to analyze the credit financing problems of commercial banks and micro-enterprises, discuss the pre-loan investigation of commercial banks and micro-enterprises and provide some suggestions for the financing difficulties of micro-enterprises.

1.3 Research Significance

Researchers have made some explorations on the financing of micro-enterprises. However, the relevant policies for micro-enterprises have not yet formed an integral system. There is still a certain gap in the research on the credit of commercial banks and micro-enterprises in the post-epidemic period. This paper will conduct further research and discussion. According to the survey response of micro-enterprises to banks and whether commercial banks borrow or not, this paper takes the early credit survey of commercial banks for micro-enterprises as the research object. Using the game method to analyze the strategy, the research results are obtained, and finally provide suggestions for the financing methods of micro-enterprises.

2. Game Theory Analysis of Commercial Banks and Micro-Enterprises in Pre-loan Investigation

2.1 Game Participants

The main body of the game is commercial banks and micro-enterprises. Micro-Enterprises need a large of financing funds during the operation stage, and the credit loan of commercial banks is the main source of financing funds for Micro-Enterprises. Both sides of the game are self-funded enterprises, and both are rational. They will make decisions based on the maximization of their income effect and choose the optimal strategy.

2.2 Prerequisite Setting

Assuming that there is information asymmetry between micro-enterprises and banks. Banks can not fully know all the information about micro-enterprises in the early investigation to determine

whether to borrow from micro-enterprises. Micro-Enterprises do not know what standards they need to meet to obtain bank loans. This model is based on a static game with incomplete information. The two sides of the game are one-time transactions independent of each other [2]. Finally, assuming that no matter what measures micro-enterprises make during the bank survey, the amount of bank lending is the same.

2.3 Game Stage

2.3.1 The First Stage

Under the premise that commercial banks judge whether to lend to micro-enterprises, micro-enterprises begin to act in this game. There are two truthfully responding to the survey of commercial banks and information fraud responding to the survey of commercial banks.

2.3.2 The Second Stage

In this stage, commercial banks should analyze the response of micro-enterprises to the loan survey, and decide whether to lend. In the game process, commercial banks do not know which coping strategy the micro-enterprises adopted in the previous stage, so they have two choices of borrowing and non-borrowing for the two strategies of micro-enterprises.

2.4 Game Model Expression

In the face of the loan demand L of micro-enterprises, banks can choose to investigate the basic situation of enterprises to determine whether to lend to them. The investigation cost of banks is C_1 , and the lending rate of the amount of loan L to micro-enterprises after an investigation is set as I . Micro-Enterprises have different responses to the survey, and the risks borne by bank loans are also different. Micro-Enterprises respond truthfully to the survey selection. The risk to be borne by banks after borrowing is set as R_1 , and the risk to be borne by banks after corporate information fraud is set as R_2 . At this time, $R_2 \geq R_1$.

In the face of bank loan investigation micro-enterprises to carry out some preparatory work, the preparation of bank review materials, need to spend a certain loan preparation cost C_2 . If micro-enterprises decide to face the investigation for information fraud and improve the success rate of loans, enterprises will spend a certain amount of manpower and material cost F to carry out information fraud. If the bank decides to lend money to the enterprise after investigation, the enterprise can use the amount L to create project income N .

Since there is a certain relationship between the income after a bank loan and whether micro-enterprises face the pre-loan investigation of information fraud. We can set the parameters P_1 and P_2 , where P_1 is the repayment probability of enterprises responding truthfully and P_2 is the repayment probability of enterprise information fraud. In response to the bank survey, the late revenue of bank loans is P_1LI , which is the result of the multiplication of loan amount L , loan interest rate I and repayment probability P_1 . If enterprises respond to information fraud in the face of bank surveys, due to the different repayment probability, the late revenue of bank loans is P_2LI .

Table 1. List of Credit Parameters

| | |
|-------|---|
| C_1 | Bank investigation cost |
| R_1 | Risks of bank lending after micro-enterprises respond truthfully |
| R_2 | Risks of bank lending after information fraud response by micro-enterprises |
| I | Bank lending rates for micro-enterprises |
| F | Fraud cost of micro-enterprises |
| C_2 | Loan cost of micro-enterprises |
| L | The capital gap that micro-enterprises need loans |
| N | Project income of micro-enterprises |
| P_1 | Repayment probability of real response by micro-enterprises |
| P_2 | Repayment probability of information fraud in micro-enterprises |

In the game process, micro-enterprises face the pre-loan investigation has the truthful response and information fraud response two kinds of response way to choose and commercial banks face the investigation response and also have borrowing and no borrowing two kinds of choice. Since micro-enterprises act first, commercial banks do not know how micro-enterprises respond to the loan survey when choosing whether to borrow from micro-enterprises. Finally, four game strategies will be formed, namely, (truthful response, lending), (truthful response, no lending), (information fraud, lending) and (information fraud, no lending).

If micro-enterprises choose to respond truthfully to the bank loan investigation, commercial banks also choose to lend to them, and the game strategy is (truthful response, lending). The income of micro-enterprises = $-C_2 - LI + L + N$. The enterprise deducts the borrowing cost C_2 prepared in the face of bank investigation and the borrowing interest LI that needs to be returned to the bank later and obtains the loan amount L of the bank and the project income N that can be obtained by using L later. In the strategy model, the income of bank = $-C_1 - R_1 - L + P_1LI$, commercial banks deduct the previous survey cost C_1 , pay the amount of borrowing L , need to bear the risk of micro-enterprises do not repay after borrowing R_1 , later will also get interest income P_1LI .

If micro-enterprises choose to respond to information fraud in the face of bank loan investigation, banks choose to lend to micro-enterprises, the game strategy is (information fraud, lending). The income of micro-enterprises = $-C_2 - F - LI + L + N$, which is similar to the income of bank loans after the truthful response, only needs to deduct the fraud cost F . The income of bank = $-C_1 - R_2 - L + P_2LI$, the bank deducts the investigation cost C_1 and the loan amount L , undertakes the risk of lending after information fraud R_2 and will obtain the interest income P_2LI in the face of enterprise information fraud response.

If commercial banks decide not to lend money to micro-enterprises after investigation, there will be two game strategies, namely: (truthful response, no lending), (information fraud, no lending). No matter whether micro-enterprises face the investigation of information fraud response, the bank needs to deduct only the investigation cost C_1 , the income of commercial banks = $-C_1$. The truthful response of micro-enterprises has lost the borrowing investigation cost C_2 , while the information fraud response has lost the borrowing cost C_2 and the fraud cost F .

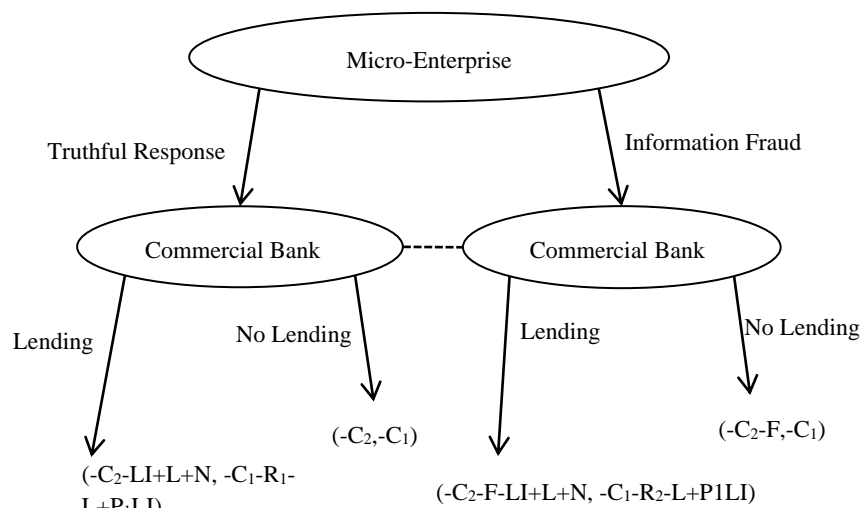


Fig 1. Game Model Diagram

2.5 Game Strategy

2.5.1 Game Strategy Analysis of Banks

In reality, the “financing difficulty” of micro-enterprises is compared with large enterprises. For banks, the risk of lending to large enterprises is much lower than that of lending to micro-enterprises. Because large enterprises have assets to mortgage in the face of borrowing, and the survival time of

large enterprises is long, they also can withstand certain market risks. For example, large enterprises can withstand the negative impact of the epidemic, while micro-enterprises have suffered heavy losses during the epidemic. For micro-enterprises, the funds of many micro-enterprises are limited, and there is no collateral for the bank to mortgage loans. Micro-Enterprises have low-risk tolerance and a short life span in the face of market volatility. Banks choose to lend money to micro-enterprises in the case of limited funds. No matter how micro-enterprises respond to the bank's previous loan investigation, due to the limited risk tolerance of the enterprise itself, if it encounters some unexpected situations after receiving loans, it may lead to all losses of the bank's loan amount and investigation cost. Therefore, banks will not choose to lend to micro-enterprises after the overall assessment of the lending risk.

From the game point of view for the banks, due to the large enterprise capital demand is more, and large enterprises to the bank loan, most of the repeated game, will loan to the bank many times so that the bank can obtain long-term loan repayment support, bring long-term benefits to the bank. However, it is also possible that large enterprises will be a variant of repeated games. Enterprises can choose not to borrow from the same bank or may borrow from multiple banks before and after the same period so banks cannot guarantee their long-term benefits. Micro-Enterprises apply for loans from banks. Due to the capital demand is not much, most of the loan game is also one-time. It is likely that when the repayment time comes, even if micro-enterprises have funds to repay, they will not refund the bank, which will significantly improve the loan risk, resulting in bank losses. In addition, in the pre-loan survey, micro-enterprises may respond to information fraud in the face of the investigation because they want to obtain borrowing funds. In this case, enterprises' action control and risk control ability are deficient, or even close to 0, resulting in a very high-risk R_2 . Therefore, the probability of the final return of bank borrowing will be less than 0, and the bank chooses not to borrow as the dominant strategy.

Therefore, for banks, no matter how micro-enterprises choose, lending is always a bad strategy. The dominant strategy is not to borrow, that is, the formation of two strategic behaviour: (truthful response, no lending), (information fraud, no lending).

2.5.2 Game Theory Analysis of Micro-Enterprises

Whether banks lend loans to micro-enterprises is unknown. Assuming that banks lend after investigation, micro-enterprises have two choices to respond to the pre-loan investigation of banks. One is a real response, the final return = $-C_2-LI + L + N$. The other response to information fraud with a return = $-C_2-F-LI + L + N$.

Micro-Enterprises falsification is to have greater opportunities to obtain bank loans L , but when micro-enterprises own economic and technological capabilities are limited, information falsification will form a higher cost of falsification cost F . Falsification cost too high will increase the financial pressure of micro-enterprises, and even if the enterprise information falsification is not guaranteed to obtain bank loans, there is a risk of fraud returns, it is likely to make micro-enterprises F loss, L can not be obtained. Therefore, micro-enterprises considering the risk of fraud return, in the face of the early investigation will choose the real response.

If micro-enterprises assume that banks will not lend money after investigation, then if they falsify the response, they will not only lose C_2 but also the cost of falsification F . Therefore, no matter whether the enterprise predicts whether the bank will lend or not, information fraud is not its dominant strategy.

Finally, the final equilibrium strategy is the repeated elimination of bad strategies (truthful response, no lending).

3. Suggestions

Based on the above analysis results, it can be known that commercial banks believe that most micro-enterprises in the market have low credit, resulting in the situation that commercial banks are reluctant to lend. In this case, even if micro-enterprises do not fake information in the face of the loan

survey of commercial banks, commercial banks will still choose not to lend to micro-enterprises, resulting in the financing difficulty of micro-enterprises.

Accordingly, micro-enterprises in financing difficulties are due to the following reasons. Firstly, due to the information between banks and enterprises being asymmetric, commercial banks cannot correctly understand the actual situation of micro-enterprises in general, and the credit level of micro-enterprises in China is not high as a whole. Banks also need to pay a certain cost for investigating and evaluating micro-enterprises. Therefore, the bank loan after loan evaluation, also need to bear great risk, so many commercial banks will choose not to borrow. Secondly, credit system construction is not completed, the overall credit level of micro-enterprises is not high, and micro-enterprises' credit loss caused by reputation is not enough to make micro-enterprises consciously abide by the contract, timely repayment [7]. Thirdly, commercial banks for micro-enterprise loan demand promotion of credit products are not perfect, but also hinder the development of commercial banks' micro-enterprise loan business, resulting in micro-enterprise financing difficulties.

This paper states the game between micro-enterprises and banks and puts forward three suggestions to improve the problem of the "financing difficulty" of micro-enterprises.

3.1 Strengthening the Construction of Information Disclosure System and Improving the Information Transparency of Micro-Enterprises

The government should play the role of macro-control and increase the comprehensive construction of information disclosure systems for micro-enterprises.

Strengthening enterprise information disclosure, the government and relevant regulatory authorities should formulate a punishment law for fraud to enhance the information transparency of micro-enterprises. The government can also establish an enterprise information database, regularly check or spot-check the financial information of micro-enterprises, and upload the basic information to the database on time, so that commercial banks can more comprehensively grasp the operation status of micro-enterprises in the loan investigation. This will greatly reduce the information asymmetry between the two sides, dispel doubts for commercial banks in the face of micro-enterprises investigation information fraud, and improve the success rate of commercial banks for micro-enterprises lending [8].

3.2 Strengthening Enterprise Credit Construction and Promoting Long-term Cooperation between Commercial Banks and Micro-Enterprises

If the transaction between commercial banks and micro-enterprises is a process of a repeated game, in process of a repeated game, the behaviour of both commercial banks and micro-enterprises has historical observability. Although the lending bank is not fixed, micro-enterprises are "long-term participants". Other banks can learn about micro-enterprises' historical behaviour from the transaction records. The credit system's role is to significantly improve the default cost of micro-enterprises, which has a restriction [7].

Micro-Enterprises themselves should also pay attention to reputation and cooperation, pay attention to their reputation construction, especially in the infinite repeated game, enterprises to obtain long-term development and long-term interests, in the early loan investigation period, need to prepare material information, establish good credit records in daily contact with the bank, as far as possible to avoid the occurrence of bad records and default conditions, establish a long-term vision, strive to obtain more game opportunities, and commercial banks to establish a long-term trust relationship, and pay attention to improve the management level and profitability, strengthen their strength [9-10].

3.3 Strengthen the Innovation Ability of Commercial Bank Credit Products, Improve the Product Matching Degree between Banks and Micro-Enterprises.

Because micro-enterprises have specific development characteristics and methods, commercial banks can carry out the innovative promotion of some credit products for micro-enterprises. Product innovation should combine the credit demand and development characteristics of micro-enterprises,

pay attention to the development needs of banks, and introduce products that adapt to the development of both sides. Micro-Enterprises see the application conditions of bank loan products, can see what product standards they meet, in line with bank lending conditions, and quickly find the enterprise and bank matching products. This can improve the matching degree between banks and enterprises, simplify the preliminary investigation of banks to some extent, and reduce the probability of micro-enterprises responding to the fraud of the preliminary investigation information of banks [10].

4. Conclusion

4.1 Research Finding

By constructing an incomplete information static game model, this paper discusses the pre-loan investigation of commercial banks for micro-enterprises. In this paper, commercial banks for micro-enterprise loan survey response results are analyzed as part of the loan reference. Micro-Enterprises also have two ways of responding to the survey: serious response and information fraud response. The game analysis is carried out according to the response results of commercial banks and micro-enterprises, and the bad strategies are eliminated repeatedly. It is concluded that even if micro-enterprises face the loan survey and choose a real response, commercial banks will still appear “credit crunch” situation, resulting in financing difficulties for micro-enterprises. Through the analysis of the game results, it is found that information asymmetry and imperfect credit systems are the main causes of commercial banks’ credit crunch. Banks cannot fully grasp the credit level of micro-enterprises, and thus cannot make a relatively correct assessment of loan returns, resulting in the frequent occurrence of “loan shyness”. And the bank for small and micro-enterprise loan demand launched credit products are not perfect, for enterprise financing also caused some difficulties. Accordingly, this paper puts some suggestions for strengthening the construction of credit systems, information disclosure systems and bank product innovation. This has improved the information transparency of micro-enterprises, and also restricted the credit behaviour of enterprises. It urges commercial banks to master the operation status of micro-enterprises more comprehensively and enhance the success rate of lending.

4.2 Future Prospect

Under the background of the post-epidemic era, this paper studies the problem of the “financing difficulty” of micro-enterprises. From the perspective of strengthening credit system construction, information disclosure system construction and strengthening bank product innovation, some suggestions are put forward to solve the financing difficulties of micro-enterprises. Micro-Enterprises play an important role in economic growth. They can stimulate economic growth and increase market vitality in a short time. Especially in the post-epidemic period, solving the financing difficulties of micro-enterprises can more effectively promote the healthy and long-term development of micro-enterprises, and also play a good role in the overall economic development. A large number of micro-enterprises can also increase employment, improve employment rates, and make society more stable. This study not only provides some reference value for the financing of micro-enterprises, to better develop micro-enterprises and promote economic and social progress. At the same time, this study also has a certain role in promoting the innovation and development of micro-enterprises and commercial banks in credit construction.

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