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Research on Lagrange method for optimal modeling of Aeronautical financial organization scale

Li Xiaohe[2,3]

Abstract. The high-tech enterprise of aviation port area has the characteristics of high risk and high profit. In the initial stage of the enterprise, there is a lack of qualified collateral and collateral. So it is difficult to obtain loans from large commercial banks. Based on private information financial organizations can better solve this problem. International experience shows: if the financing capacity is expanded, such financial organizations can not finance high-tech enterprises in aviation port area. To explain the optimal financing scale of financial organizations, new economic model is needed.Using the Lagrange method this paper constructs a model of Limited supply capacity from the perspective of private information. The main conclusions include: Each new financial organization can only provide financing services for a limited number of emerging high-tech enterprises because of limited supply capacity; the expansion of the number of such financial organizations is the key to solve the financing difficulties of high-tech enterprises.

Key words. technology finance, private information, limited supply capacity, financial coverage degree.

1. Introduction

Civil aviation is the main transportation channel of the subject enterprise in aviation economy. They produce products with high added value and high timeliness. Comprehensive test area of Zhengzhou airport is one of the three core strategies in Henan. It entered the country in 13th Five-Year plan in 2016. In the construction of inland open economy, it is an important support for Henan province and even the whole country. Civil aviation is the main means of transport for aviation economy. It determines the characteristics of the products with high added value and high

timeliness. So it has the possibility and necessity of aviation economy. This means that high-tech enterprises are the main participants in the aviation economy [1]. The construction and development of aviation economy requires the cultivation of high tech Enterprises. The rapid transportation of high added value and high efficiency products is the prerequisite for the existence and development of aviation economy. Such enterprises are an important member of high-tech enterprises. Civil aviation is the main means of transport in aviation economy. Compared with the highway, railway, river and ocean transport, air transport is faster and higher cost [2]. If the added value of the product is not high enough, the company may not be able to bear the cost of air transport. If the shelf life of the product is longer, other modes of transport will bring greater profits, and air transport will be lost. Product shelf life not only refers to tangible quality, but also intangible quality. Therefore, it can be generalized that the product does not produce visible or invisible wear and tear. Timely listing of products has become an important means of competition because of the fierce market competition. Economic globalization compresses the shelf life of products. Enterprises need faster transportation than ever before, and the market demand of civil aviation is more and more urgent than ever before. In the start-up stage of high-tech enterprises, the lack of tangible assets, intangible assets, such as technology is in the larger proportion of total assets. This makes it difficult for companies to review loans through large commercial banks, because of the lack of qualified collateral and collateral. Lack of collateral and guarantee in high-tech enterprises, it reduces the security factor of large commercial banks and increases the risk. If the loan risk has nothing to do with the loan interest rate, these risks can be covered by raising enough lending rates. Banks will provide loans to high-tech companies at high interest rates. But unfortunately, due to the existence of asymmetric information before and after, interest rate bidding will only attract high-risk investment projects and the applicant has a higher tendency to malicious default. Taking this into consideration, the large commercial banks will be required to provide sufficient qualified collateral and collateral for loan applicants of high-tech enterprises. In the start-up period most high-tech enterprises do not have this condition. The information barrier restricts the ability of large commercial banks to lend between high-tech enterprises and large commercial banks. They do not have the ability to provide loans to start-up high-tech enterprises. If these companies can not be integrated into other funds, they are unlikely to survive to maturity. Aviation economy is only a mirage and insubstantial objects. In the initial stage, the financing difficulties of high-tech enterprises are ubiquitous in the world. Although the law of coping is different in form in different regions, it has important similarities. That is compressed lending process, by using more private information. At last, Credit rationing can be overcome due to lack of public information. Such as the U.S. venture capital, Japan's main banking system and China's private lending. These new types of financial organizations are based on the private information between acquaintances. They can provide financing services for the high-tech enterprises with lack of assets [3]. The rapid development of new financial organizations has eased the problem of credit rationing in China's emerging high-tech enterprises. As a by-product, there has been a strong voice calling for an expansion of its financing capacity. However,

in terms of international experience, there is an inverted "U" relationship between the size of the financial organization and the financing of the emerging high-tech enterprises. Once the size of the financial organizations breaking through a critical point, it will gradually lose the ability to provide financing services for emerging high-tech enterprises. Based on the view of science and technology finance, the new financial organization's financing scale should be limited. This paper tries to depict the relationship from the theoretical model, and then analyzes the main factors that affect the optimal financing scale of the new financial organizations in the air port area.

2. The financial organization's loan ability model basing on Private information

2.1. Limited capacity of a single lender

It is assumed that there are a large number of scattered high-tech enterprises (potential borrowers) and a potential lender in the port area. These high-tech enterprises are uniformly distributed in the region and there is no qualified collateral and collateral, which is faced with large commercial bank loan technology automatic exclusion [4]. Private information can break the barriers between high-tech enterprises and financial organizations. There is a negative correlation between the amount of private information and the distance between the two places. When the distance increases so that the number of private information can not meet the minimum requirements of microfinance technology, there is a border of loan capacity. Emerging high-tech enterprises and lenders together form a closed circular area within this boundary distance. It is called the information island. As shown in Figure 1, it forms a small acquaintance society. The rectangular area represents the giant society of modern humans in Figure 1, and the five-pointed stars represent the emerging high-tech enterprises. The elliptical area represents the information island. The five-pointed star represents the potential lender on the island of information [5]. The lender may provide microcredit services to emerging high-tech enterprises in the island of information.

$$\begin{cases} \dot{z}_i = z_{i+1}, \ 1 \le i \le n-1 \\ \dot{z}_n = F(Z(t)) \end{cases} \tag{1}$$

Where $Z(t) = \begin{bmatrix} z_1(t) & z_2(t) & \cdots & z_n(t) \end{bmatrix}^T$ is state vector. It is assumed that the scalar function $F(Z(t))$ is satisified the global Lipschitz condition. That is,

$$|F(Z(t))| < \rho_0 + \sum_{i=1}^{n} \rho_i \, |z_i| \tag{2}$$

Among them, B is the largest number of lenders can lend high-tech enterprises; D represents the distance between the lender and the emerging high-tech enterprises; A represents the radius of the information island; and B0 represents the number of
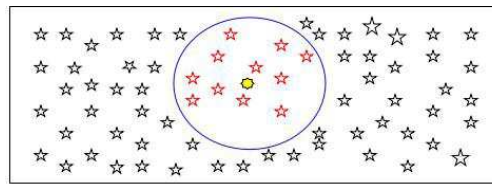
Figure 1 Single lender's information island

Fig. 1. The model of control and performance in cross-boarder acquisition

emerging high-tech companies on the island of information. The maximum capacity of the lender is equal to the number of new high-tech enterprises multiplied by the maximum amount of loans of individual emerging high-tech enterprises. The maximum loan amount of a single borrower is related to the borrower's subjective willingness to default. Although in the acquaintance society the borrower can suppress malicious breach of contract by spreading the borrower's malicious default information, its effectiveness depends on the comparison of the benefits and costs of the borrower to the malicious default. Only when the cost of malicious breach is greater than the cost of the proceeds, the borrower will choose the rational repayment.

$$\begin{cases} \dot{x}_i = x_{i+1}, \ 1 \le i \le n-1 \\ \dot{x}_n = F(X(t)) + \Delta f(X(t)) + u(t) + \Delta(t) \end{cases} \tag{3}$$

$$e_i(t) = x_i(t) - z_i(t), \quad i = 1, \cdots, n. \tag{4}$$

$$\begin{cases} \dot{e}_i = e_{i+1}, \ 1 \le i \le n-1 \\ \dot{e}_n = F(X(t)) - F(Z(t)) + \Delta f + u(t) + \Delta(t) \end{cases} \tag{5}$$

$$s(t) = e_n(t) + \int_0^t \sum_{i=1}^n c_i e_i(\tau) d\tau \tag{6}$$

Among them, LBORROW represents the emerging high-tech companies to bring net profit default. When it is greater than zero, Breaching of contract is the best choice. On the contrary, no breach is the best choice. RBORROW represents the benefits of default to emerging high-tech companies, equal to the sum of the loan amount and loan interest rate. CBORROW represents the cost of default to emerging high-tech enterprises. W represents the need to re live in the field of monetary wealth. Q represents the loan principal, and R represents the loan interest rate. By (3) to (6), the maximum loan amount is:

$$\begin{aligned} \dot{e}_i &= e_{i+1}, \ 1 \le i < n \\ \dot{e}_n(t) &= -\sum_{i=1}^n c_i e_i(t) \end{aligned} \tag{7}$$

When the loan amount is greater than Q0, the optimal choice is default. So Q0 is the maximum amount of loans that lenders can offer to the emerging high-tech companies. The largest supply of lenders is the number of emerging high-tech

enterprises on the island of information B0 multiplied by Q0.

$$\dot{E}(t) = AE(t) \tag{8}$$

The boundary of the information island provides the maximum supply capacity of the financial organization, and the supply capacity of individual lenders is limited, as shown in formula (8). If the lender's ability to borrow is less than or equal to the border, then all of its available loans will be used to finance the emerging high-tech companies [8]. If the loan capacity is greater than the border, then after the micro credit, there will be a balance, the formation of excess credit supply. This balance will form the opportunity cost of microfinance.
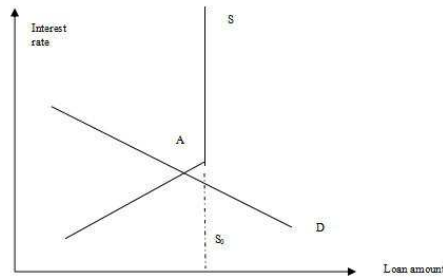

Fig. 2. The model of control and performance in cross-boarder acquisition

As shown in Figure 2, under the constraints of the island of information, when lenders provide credit services for emerging high-tech enterprises, it has only a limited supply capacity. The boundary of the information island determines the lender's maximum supply capacity S0. In Figure 2, the lender's loan supply curve is divided into two parts. It is formed by the combination of a right upward sloping part and a vertical part. On the left side of S0, the supply curve tilts to the right, which means that with the increase of loan interest rate, the lender's optimal loan amount increases. At S0, the supply curve is vertical, representing the lender's loan margin to the boundary of the information island. Unable to provide more loans, even if the loan interest rates rise, the lender will not increase the optimal loan amount.

2.2. Limited supply ability of financial organization

By modifying the assumptions in the above model, the model can analyze the supply capacity of financial organizations in this market. Similarly, with the assumption that there are a large number of scattered emerging high-tech enterprises in the region, they are lack of qualified collateral and collateral, there is reliable private information between acquaintances. At the same time, we assume that there is a financial organization outside of the acquaintance society, which can provide the credit service to the emerging high-tech enterprises by employing the insiders as their agents. If financial institutions can hire enough insiders, then in theory they can cover all the emerging high-tech enterprises in the economy. But the size

of the financial organization can not be infinitely expanded, because the number of people it can employ is constrained by the cost of management. Employing insiders, financial organizations save transaction costs, while generating management costs. With the increase of the number of employed persons, the saving transaction costs and management costs are increased. The maximum amount of employment is determined when the marginal transaction cost is equal to the marginal cost of management. It is possible for financial organizations to employ limited insiders to provide microfinance to emerging high-tech enterprises. It can be speculated that will still form an information island, even if the introduction of external financial organizations, as shown in Figure 3. The area is larger than that of a single lender, but there is still a border. Because of the existence of information island boundary, financial organizations can only provide financial services to a limited number of emerging high-tech enterprises. There is a maximum possible supply of loans, but only a little more than a single lender.
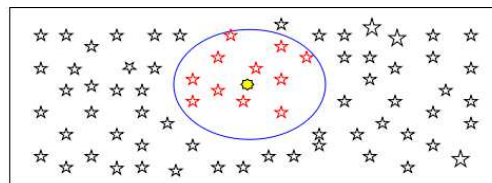
Figure 3 Information islands of financial organizations

Fig. 3. The model of control and performance in cross-boarder acquisition

As shown in Figure 4 and Figure 5, in the lending market using private information, the ability of new financial organizations to provide loans also has a boundary S0. On the left, the loan supply curve tilts to the right. But after reaching the border, rising interest rate will not lead to an increase in loans.
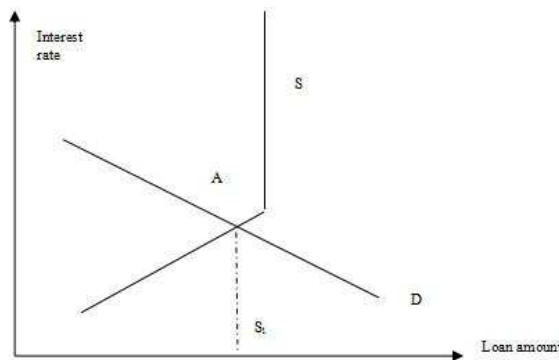
Figure 4 Limited supply capacity of village banks

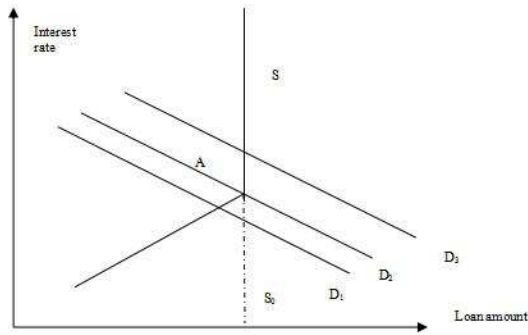Fig. 4. The model of control and performance in cross-boarder acquisition

Fig. 5. The model of control and performance in cross-boarder acquisition

3. The influence of financial organization's financing ability on the financial coverage based on Lagrange method

After the new financial organization's financing ability is greater than the maximum supply capacity S0, the credit supply balance will be formed. This balance forms opportunity cost. With the increase of opportunity cost, the optimal scale of financing descent for the emerging high-tech enterprises. If the opportunity cost is large enough, it will lead to financial organizations to completely give up financing for emerging high-tech enterprises. Under the guidance of individual rationality, the optimal scale of the new financial organization appears when the marginal revenue of the last unit loan is equal to the marginal cost. The product of the number of loans and the interest rate is the yield of the loan.
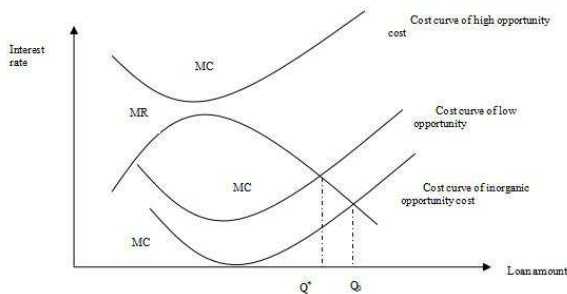

Fig. 6. The model of control and performance in cross-boarder acquisition

The R on the left side of the equal sign represents the marginal revenue, and MC1+MC2+MC3 represents the marginal cost, where MC1 represents the marginal cost of production, MC2 represents the marginal cost of management, and MC3 represents the marginal opportunity cost. As shown in Figure 5, driven by profit maximization, the optimal scale of financing for emerging high-tech companies in the

financial sector appears in the intersection of MR and MC curve A corresponding to the Q*. With the increase of excess loan supply balance, the opportunity cost of financial organization increases accordingly. In Figure 6, the MC curve moves up, and the intersection with the MR curve shifts to the left. The optimal size of such financial organizations Q* is corresponding reduction. Excessive financing capacity is not conducive to financial organizations for the financing of high-tech enterprises. In extreme cases, if the excess loan supply balance is large enough, the opportunity cost of financial organizations will be very high, so that the MC curve rose sharply, and the MC curve of each point is higher than the MR curve. At this point, the financial sector will completely abandon the financing of emerging high-tech enterprises credit business. Therefore, there is an inverted U relationship between the financing capacity of the financial organization and the financing of the emerging high-tech enterprises, as shown in figure 7. In the financial organization's capital is lower than its limited supply capacity of S0, the increase in financing capacity is conducive to the financing of emerging high-tech enterprises. But after the capital is more than the limited supply capacity S0, financing capacity is not conducive to the financing of emerging high-tech enterprises.
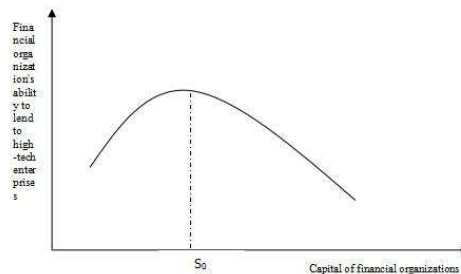

Figure 7 The inverted U relationship between the financing ability of financial organizations and the service of high-tech enterprises

Fig. 7. The model of control and performance in cross-boarder acquisition

Financing for emerging high-tech enterprises based on private information, it expands the financial coverage of financial organizations[9][10], and restricts the financial coverage of financial organizations[10][11]. The number of effective loan supply of new financial organizations is restricted by the information island. Once the loan capacity exceeds the border, the opportunity cost will be formed, and the optimal scale of financing for emerging high-tech enterprises will be reduced.

4. Policy suggestion

By using private information, financial organizations expand the financial depth of financing for emerging high-tech enterprises, but also limits the scope of financial coverage. They have only a limited supply of loans. First, the size of the financing of new financial organizations should be limited. In view of the serious credit rationing problem faced by high-tech enterprises, the functions of such financial organizations

should be limited to providing credit services for similar customers, such as emerging high-tech enterprises. Second, the number of new financial organizations should be further increased. The scope of financial coverage of a single organization is limited. So they can cover more vulnerable groups, by increasing their number. Another advantage is that the interest rate can be reduced. Private information has a certain nature of monopoly, which hindered the entry of large commercial banks in this area. Driven by economic rationality, financial institutions may require a higher loan rate. If the number of financial organizations is enough, the information island will overlap. Then competition appears. Competition can depress lending rates and improve financial services for emerging high-tech companies. Third, the new financial organization executives access and business access should be strengthened, because it can reduce the risk. While expanding the number of market access restrictions, Executives access and business access needs to be strengthened to reduce the possible financial risks. After a large number of financial organizations to finance, there may be moral hazard. Companies do not strictly use the financing or change the original purpose, which will bring some financial risks. This risk can be effectively controlled by strengthening executives and business access.

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