SME Credit Guarantee in China and Risk Evaluation

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Abstract

As a product of the development of the market economy, credit guarantee is relatively new to China, and there are some defects in the system. It is of significance to construct and improve the current credit guarantee system, which helps to improve the credit rationing of banks and to solve the financing problem of SME (small and medium-sized enterprise) effectively. This paper provides a comprehensive analysis of the current situation of domestic and international credit guarantee market, with a focus on its development in China. I discuss current credit evaluation models, and extends the pricing method into multi-stage based on the current two-stage VaR (Valuation at Risk) model. Overall, this paper provides suggestions conducive to SME credit financing system design.

Key Words: SME; Credit guarantee; VaR (Valuation at Risk); Credit Rating

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Reference

1 Overview of SME credit guarantee

1.1 Definitions of SME credit guarantee

As a special kind of intermediary service, credit guarantee is an institutionalized assurance provided by specialized agencies for the community. As a product from the development of the market economy, credit guarantee proves the credibility and asset combined responsibility. In the market economy, it is the objective requirement of various trading activities in credit and social risk management.   It   should   be distinguished from insurance, as guarantee institutions are responsible to pay back the loan after the date of maturity, while insurance companies bear limited responsibility.

With the improvement of the financial market, SME (small and medium enterprise) credit guarantee is becoming more common. SME credit guarantee is a specialized guarantee for SMEs to get loans from financial institutions, mainly by the government funding. It is a variety of means and measures to realize and protect the creditors' rights to ensure the payment of the debt on the basis of the property (or capital). The fundamental function of credit guarantee institutions is to bridge between SMEs and financial institutions, so as to solve the financing difficulty for SMEs and resolve the worries from the financial institutions' side.

1.2 Significance of SME credit guarantee

(1) Effectively solve the problem of high financing cost for SMEs

Once credit guarantee system is established, the cost of financing for SMEs is only loan bank interest plus a certain amount of the fee, much lower than the cost of private funding, thereby reducing the cost of financing for SMEs. Results in Mu, Yibin[1] suggested that credit guarantees influenced significantly firms' ability to maintain their size, and increase their survival rate.

(2) Reduce the bank's management costs and operational risks; develop new business.

The credit guarantee agencies can simplify the procedure of lending from bank to SMEs. Also, the institutions deal effectively with the bank's solvency crisis, which reduces the

bank's non-performing loans and hence stimulates the banks to open up new credit business.

(3) Serve as an economic lever

Compared to non-professional guarantee and general corporate institutions, credit guarantee system overcomes the shortcomings of spontaneity, fragmentation of the credit guarantee system. Its magnification function makes credit guarantee work as an economic leverage in the process of social resource allocation, which helps with government regulation of the development of SMEs. In general, the higher magnification ratio, the greater it contributes to society. A balanced credit guarantee system means that guarantee institutions undertake risk systematically in accordance with the specific goal of SMEs, its own strength, and reputation.

(4) Benefit the construction of social credit system

Finance is the core of modern economy while credit is the core of the financial sector. The guarantee industry is an extension of the financial industry. Credit guarantee, as a starting point in the economic life of the most sensitive areas, directly urges businesses or individuals to increase credit awareness, concern and attention to their own credit building.

(5) Promote the development of the credit rating agencies

Credit rating is part and parcel of the social credit system. Financial institutions and guarantee agencies take full account of the evaluation from the rating agencies in selecting customers and guarantees. For financial institutions and guarantee agencies, the rating process saves the cost of collecting information. For SMEs, they prove their creditability to obtain a qualification. For rating agencies, although they do not have to be responsible for the legal consequences caused by the evaluation reports, they must bear the survival risk for their own evaluation quality. Therefore, the potential risk propels them to improve the scientific evaluation system and evaluation quality.

Above all, it is significant to analyze the credit guarantee market thoroughly both for the SMEs and the entire market system. The study is designed to solve the dilemma

of SME credit guarantee and to provide valuable theoretical reference and suggestions for policy-making departments.

1.3 Domestic and international situation of SME credit guarantee

In November 1993, the first professional credits guarantee institution was established--Chinese Economic and Technological Investment Guarantee Co. Ltd. During the short history of fewer than twenty years, SME credit guarantee industry has a rapid development. At of the end of 2008, according to statistics of the Ministry of Industry and Information Technology, the national SME credit guarantee institutions has reached 4247, the guarantee funds of 233.4 billion yuan, the cumulative amount of guarantee SME loans reached 1.75 trillion yuan, and the cumulative number of guaranteed enterprises is 90.7 million. In late 2011, the total institutional national financing guarantee corporations reached 8402, an increase of 39.3% compared to the end of 2010; ensure the balance of a total of 1.912 trillion yuan, an increase of 39.1% compared to early 2011. As at the end of June 2012, a total national financing guarantee industry institutional 8538, representing an increase of 136 from the beginning of the year; financing guarantee loan balance of 1.3569 trillion yuan, an increase of 9.2% compared with the beginning of the year.
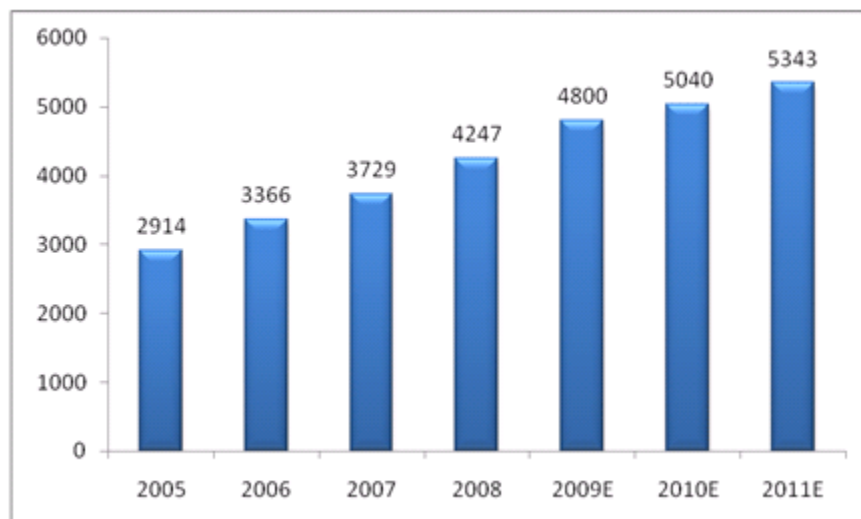

Figure 1.1: Quantity of Chinese Guarantee Agencies, 2005-2011 (Source: Research In China)

With the fast expansion of funding and volume of business, credit guarantee institutions still adhere to SMEs. In 2008, nearly 384,000 deals were among the total 400,000 deals (the total amount of guarantee fund reached 800 million), accounting for 96%. Besides, the scale is still in accelerating expansion. What we should be aware is the risk of the "boom", a disorderly growth. According to the survey [3], at the end of 2001 in the small and medium-sized enterprises of the Industrial and Commercial Bank of China for credit rating, a credit rating of A more accounted for only 16.2% in the BBB and below accounted for 83.8%. Over the same period, small and medium enterprises to obtain credit from state-owned commercial banks account for only 38% less than 20%, only in the incremental credit. credit transactions paradox of objective interpretation of the source of financing difficulties of SMEs shows that at the same time, the credit market urgently needs professional intermediaries to build the bridge between SMEs and bank credit.

Another problem arose as there were few credit rating assessments for SMEs in China, and consequently, banks had little information about the SME's credit records. On the other hand, SMEs do not have incentives to establish their own credit reputation as no one evaluates their credit situation, and whether they honor loan contracts did not make much difference in their future borrowing. This has caused poor quality of the loans to SMEs and made banks reluctant to extend loans to SMEs. To get rid of the vicious cycle due to low credit ratings or lack of credit report of SMEs, China established a nationwide credit assessment system for SMEs on April 26, 2001. This system is designed to collect, assess, and report the credit situation.

As with the international situation, Levitsky, Jacob (1987) [3] provided information on a variety of credit guarantee schemes in 27 developed and developing countries. Together with other references to SME studies [1]-[2], the following characteristics of relatively developed schemes are noted:

(1) Standard management. Many developed countries not only established strict access systems but also formulated specialized legal safeguards and norms to regulate agencies.

For example, American *SME Law* and *SME Investment Law* have clearly defined the guaranteed object, purpose, amount of the guarantee and the premium standards; Japan *SME Credit Guarantee Association Act* explicitly stipulated the functions and role of the Guarantee Associations, as well as the rules for the guarantee process. Canada *SME financing bill* build SME policy-oriented guarantee system. In contrast, China's guarantee market is lack of regulations.

(2) Specification on the objects supported by SME guarantee institutions and policy objectives. They stipulate a criterion on the size and quality of the guaranteed SMEs. The supported enterprises comply with national or local industrial policies, which are generally focused on SMEs that earn foreign exchange through exports or expand employment. Besides, given the different stages of development and management system of the SMEs, different nations provide some special support. In the USA, for example, there are SMEs guarantee institutions especially for women, the disabled, veterans, minorities, and poor areas. In contrast, the standard of the SMEs guaranteed and policies in China are vague.

(3) Regular support and supervision of the SMEs guarantee institutions. Policy-oriented governments have formulated a series of preferential policies to support the guarantee institutions, such as tax policy, macro-management and regular monitoring, and inspection of guarantee institutions for SMEs.

(4) Different structures of guarantee system according to domestic conditions. For instance, the United States implements "one-level guarantee system", setting up local branches; while in Japan, "sub-level guarantees system" is adopted, with guarantees from the public treasury of the Central Credit Insurance and local credit associations. (The public treasury provides re-guarantee for the local credit associations, in the ratio of 70% -80%.)

(5) Cooperation between guarantee institutions and bank. In other countries, the banks share the risk with guarantees agencies, based on the size and duration of the loan.

Generally, the amount of the guarantee of the SME credit guarantee institution is no more than 75% -80% of the loan; in the Japan Association, it is no more than 70% -80%. In economically developed countries, there is a more developed financial system to establish a long-term stable relationship with banks. There are a number of specialized regional financial institutions to provide financing for SMEs, which are actively involved in the SME Credit Guarantee Scheme.

1.4 Literature Review

Credit guarantee industry is internationally recognized as a high-risk industry, in addition to its risk stems from the features of the guarantee itself, but also closely relates to guaranteed objects and external conditions.

In China, many scholars analyzed the major impediments for SMEs to access finance and provided some suggestions on how to make China's CGSs (credit guarantee schemes) sustainable. For example, Mu Yibin[1] analyzed examined the evolution, categories, legal basis, operating characteristics, and key concerns of CGSs in China. The author argued that the lack of collateral, credit information and economies of scale of SME loans, coupled with high political risks associated with SME loans are the four major impediments for China's SME finance. Xiong [2] used comparative analysis and empirical analysis from the micro-level analysis----the system of commercial bank credit; middle-level analysis----the game under asymmetric information between banks and enterprises; macro-level analysis----institutional arrangements and SME credit demand dilemma. Levitsky, Jacob, and Ranga N. Prasad (1987)[3] provided information on a variety of credit guarantee schemes in 27 developed and developing countries. Their study enabled us to understand the essential elements, scope, and variety of such schemes, and the problems they face in their operations.

The paper is organized as follows, stressing the issue both at the micro and macro level. In Section 2, the paper provides macro-level analysis in terms of two major impediments—government invention, lack of proper supervision and interest rate

control. From the micro perspective, in section 3, the paper investigates the credit needs of financing environment, the SME's own weaknesses, and credit guarantee system defects. Further, with aims to provide solutions to the problems concerning the credit pricing, section 4 provides a pricing method based on VaR model. The paper considers two stages credit guarantee and extends the model into multi-stage. Besides, the paper discusses the credit rating system, extracting credit factors and introducing models. Finally, the paper provides suggestions conducive to SME credit financing system design.

2 Macro-level analysis of SME credit guarantee

The structural deficiencies and functional defects of SME credit guarantee epitomized at the macro level. Mu Yibin [1] argued that CGSs (Credit Guarantee Schemes) in China have become important tools for local governments to ensure credits to SMEs. However, government intervention, lack of proper supervision and regulation, as well as interest rate control may impede the development of CGSs.

2.1 Government intervention

According to Oh, Inha, et al. (2009)[14], the belief that capital markets do not provide adequate funds for new businesses is one of the rationales for government loan assistance programs to SMEs. In the past, China's LMEs can directly use the national credit bank loans as endogenous financing. With the establishment and development of the market economy system, this error has been corrected, linking the credit of LMEs' financing to its assets. However, it goes to the other extreme: putting too much government credit on SMEs could result in the burden of government finances, amplification of government's risk, the weakening of the market's function in risk management.

As we know, the market itself has superior management and risk diversification. But when the government excessively undertakes the risk that could originally be managed and decentralized by the market, it will inevitably weaken the market's functions. In China, a multiplication of 4.12 times for the credit guarantee is far away from the international standard of 10 times. Meanwhile, too much government guarantee will induce speculative behavior of SMEs, increasing the risk of moral hazard and SMEs' dependence on government. Due to the large quantity of SMEs and the extensive aspects covered, demand for loans of SMEs has been personalized. As a macro-controller and social manager in the market economy system, the government regulates the market and makes the market rules. But it is hard for the government to offer sufficient financial resources to dominate the guarantee system for SMEs.

All in all, the dominant role of government guarantee institutions in the whole system negatively affects the function and efficiency of the credit guarantee system.

2.2 Lack of proper supervision and interest rate control

Some credit guarantee schemes (CGSs) may cause the 'moral hazard' issue, as they weaken the will and commitment of the borrowers to repay the loan when they know that a guarantee fund will reimburse the lending institution. [15] There is also a danger of moral hazard on the part of the lending bank which has less incentive to supervise the loan properly or to pursue vigorously the collection of repayments. Proper supervision benefits the SMEs by reducing unnecessary transaction cost.

Currently, the commercial banks are allowed to charge a maximum of 30% mark up over base rate, which is insufficient to encourage the banks to lend to SMEs and reward for the transaction cost and the credit risk. [1] Domestically, most guarantee institutions charge half of the bank interest rate. It becomes a comparative advantage for guarantee institutions to attract SME. However, this may introduce the problem of over-lending if the institution fails to recognize the credit risk. Optimize the interest rate spread in the form in line with the credit risk, but it should be commensurate with the risk for companies that are faced with the situation of credit allocation. Interest payment makes SMEs get access to external funds more easily.

3 Micro-level analysis of SME credit guarantee

To some extent, guarantee fee can be considered as a kind of risk compensation for credit guarantee institutions, especially for SMEs. Smaller business enterprises in both industrialized and developing countries have difficulties in obtaining financial assistance from banks and financial institutions.

The reasons are concluded as follows: (1) The uncertainties facing the small industry, the high mortality rate of such enterprises and their vulnerability to market and economic changes make banks reluctant to deal with them, and there is a parallel reluctance on the part of SMEs to borrow from banks. (2) Banks and financial institutions are biased in favor of lending to large corporate borrowers, as there are links between banks and corporate borrowers that take the forms of joint directorships, joint ownership, and various other joint financial dealings. (3) The administrative costs of lending to small enterprises are high and cut deep into the profitability of such loans. (4) SMEs seeking loans are unable or unwilling to provide accounting records and other documentation required by banks or to provide securities or collateral for the loans. In an attempt to overcome some of these problems, particularly the perceived high risks of lending to small enterprises and their inability to provide collateral, credit guarantee schemes (CGS) have been introduced. [3]

Except for these reasons stems from the nature of SMEs, operational defects and standard credit pricing on the institutions' side are worth noting. SME credit guarantee system operating defects are mainly concluded in four ways:

3.1 Lack of financial compensation and risk diversification mechanism

The main income sources for guarantee institutions come from local government funds, the guarantee fee as a supplement resource. Governmental guarantee institutions run not for profit intention, and hence they are more competitive by charging low for SMEs. Most commercial guarantee institutions regard guarantee fee as a source of financial compensation, part of the guarantee institutions charge at half the rates as bank loans in

the same period. For most of the international countries, the guarantee fee is around 1%, France 0.6%. And it is only 0.5% in Taiwan and Hong Kong Special Administrative Region (SAR) in China.

Due to the lack of a clear specification on responsibility with the side of guarantee agencies, the guarantee institutions are in a weak position on negotiations with banks. The consequence is that they should take on more risks of SME loans, some even forced to undertake the full credit risk. International guarantee agencies generally bear only 80% of the loan obligation, the United States 80%, France 50%, Germany and Japan 50% to 80%. Guarantee institutions are also lack of risk diversification mechanism. The majority of agencies, especially the commercial guarantee institutions, seek counter-guarantee contracts to diversify risk or charge more the guarantee fee to transfer the risk.

3.2 Information asymmetry

Information asymmetry between SMEs, guarantee institutions and banks is considered as another defect. As Busetta, Giovanni, and Alberto Zazzaro (2012) argued about the adverse selection during the guarantee process [5], Xiong [2] theoretically and empirically justified that the credit market incentive and restraint mechanisms asymmetry is an important cause of formation of SME credit financing difficulties. Low ratings or lack of specific credit reporting system for SMEs impedes financing for SMEs. Also, there are few credit rating assessments for SMEs in China, and consequently, banks have little information about SME's credit records.

Take the example of a guarantee company in Jiujiang Developing District. Its cooperated bank would double check the guaranteed SMEs to ensure their credibility. In another word, both the guarantee agency and the bank inspect the SMEs' management, investigate their financial statements, and analyze their prospects etc. However, guarantee institutions for SMEs in China almost bear 100% of the loan risk. Many cooperate banks couldn't get full from SMEs or guarantee institutions. According to the

survey, at the end of 2001, among the SMEs guaranteed, a credit rating of A only accounted for 16.2% in the BBB and below accounted for 83.8%. (The credit rating is provided by the Industrial and Commercial Bank of China). The credit transactions paradox objectively explained the source of financing difficulties of SMEs, which also implied the urgent need for professional intermediaries to build the bridge between SMEs and bank credit on the credit market. [13]

3.3 Lack of collateral varieties

SMEs lack eligible collateral for loans. Banks have the duty to protect depositors' funds and are naturally risk adverse. In China, the main categories of the collaterals are properties owned by the borrowed or whoever else pledges; the right to the use of state-owned land, equipment or transportations vehicles which are at the disposal of the borrower; state-owned, etc.

Other countries, however, their guarantee variety includes business loans, bills discounting, scientific and technological development loans, equipment loans and technological innovation loans. Varieties of collaterals facilitate the process for SMEs to get adequate loans.

3.4 Lack of professionals

Some officials in local government-financed guarantee institutions are not familiar with the guarantee business. But to achieve capital preservation or gain profit, guarantee institutions need experts to manage and implement the market-oriented operation. Meanwhile, there is still no guarantee qualification system and penalizing mechanism, which leads to the lack of ability and quality.

4 Supporting systems一Pricing and Credit Rating

From the above analyses, it makes sense to evaluate the risk of credit guarantee. The supporting systems一Pricing and Credit Rating naturally become indispensable. If guarantee agencies charge too low, they will assume excessive risk, compensating for the agencies; while high fees will resist a large number of enterprises to be guaranteed. Therefore, the reasonable price of the guarantee is the basis of the existence and development of the guarantee industry. In the U.S., credit-related investments, guarantees, securities, consultants, fund institutions operate through the credit rating of the company, and the rating results directly affect the market requirements guaranteed. While in China, it is still in the elementary period.

4.1 Pricing of credit guarantee

4.1.1 Comparisons of different pricing models

Domestic credit guarantee industry is still in its start-up phase, so there are few studies about the pricing of credit guarantee. Mei Qiang, Tan Zhongming (2002) [8] analyzed compensatory rates and recovery rates, under the cases of different guarantee rates and margin rates. It assumed that the margin rate, compensatory rate, recovery rate, and interest rates can be used to determine the guarantee rate. But the method can only determine the interval of guarantee rate, rather than the exact rate. In recent years, we have witnessed an unprecedented surge in the usage of risk management practices. The main pricing methods of credit guarantee are the option pricing model, based on experience, or VaR (Value at Risk).

(1) Black-Scholes model

Scholars considered guarantee as the put option, and hence relative pricing models could be utilized. However, the Black-Sholes model relies on two main points: firstly, the price of underlying asset obeys logarithmic normal distributions; secondly, continuous adjustment for asset in infinite short period, in case of risk-free arbitrage. For the guarantee institutions aiming to serve SMEs, (i) the assets income in one period can be

much higher than another period, due to the growth of an enterprise; (ii) it is also impossible to adjust copy assets continuously.[1,6,7]Therefore, the Black-Sholes cannot fit any more.

(2) Experience-based pricing

Domestic credit guarantee industry pricing is based primarily on *The Guidance to establish SME credit guarantee system,* generally, charging of SME credit guarantee institutions guarantee fees should be controlled within 50% of the interest rates of bank loans over the same period. According to the National Guarantee Institution charging standard survey, guarantees rates typically 1% to 3%, national average about 2.5%. The pricing is based on the experience of judgment: multiply the total guarantee amount by a certain percentage, and then make adjustment to the base price. [6] This method is practical in some sense, but it only sets the price without any explanation why, just lacking of convincing reasons. With the development of the guarantee industry and fierce competition in the market, this method is limited because of its arbitrariness and high cost of negotiation.

(3) VaR-based pricing

Dennis Weatherstone clearly stated the basic question "how much can we lose on our trading portfolio by tomorrow's close?" VaR describes the loss that can occur over a given period, at a given confidence level, due to exposure to market risk. [7]

Dietsch M, Petey J.[4] computed the probability density function of futures losses and VaR measures in a portfolio of 220.000 French SMEs, and proposed specific solutions dealing with the most important peculiarities of these portfolios. While in China, Xiaohong Chen(2005) [6] was a pioneer of VaR pricing model of credit guarantee, which provided the absolute VaR method. Later, a two-stage model (the relative VaR method) was approved to be more accurate.

Compared with absolute VaR pricing model, the comparative VaR method also takes into account the deferred liability risk (the risk during the guarantee period as the

deviation from the average yield rate of the asset), which is similar to consider the budget of the time value of the asset. If the average yield rate is of positive value, the method would be more accurate and closer to the reality.

4.1.2 Mathematical Introduction of VaR model

We list the basic definitions and assumptions as follows: (referred to [4])

(1) stationarity.

A related assumption is the random walk assumption of intertemporal unpredictability; or equivalently, this can be represented as the assumption of a zero expected rate.

(2) non-negativity.

This stipulates that financial assets with limited liability cannot attain negative values.

(3) risk limit.

We assume that a guarantee institution is constrained to maintain the VaR of horizon wealth at a prespecified level.

The formula is: $prob(\Delta C \leq -VaR) = \alpha$, where ΔC is the variance value of assets in a given period, that is, ROA (return on assets). It illustrates that the probability that the loss exceeds VaR is α, or at the prob level of $1-\alpha$, the maximum loss of asset is VaR. Suppose the initial value of an asset is W, the expected return rate is λ, the volatility rate is σ, and the minimum return rate under the significance level of $1-\alpha$ is r ($r < 0$). If the probability density function of the return of the assets is $f(w)$, then we can get

$$1 - \alpha = \int_r^{+\infty} f(w)dw \qquad (1)$$

Typically, we suppose that $f(w)$ obeys normal distribution $\Phi(z)$, then the deviation rate d of r and distribution can be expressed as $d = \dfrac{r - \lambda}{\sigma}$, then,

$$1-\alpha = \int_{r}^{+\infty} f(w)dw = \int_{d}^{+\infty} \Phi(z)dz \qquad (2)$$

So under the assumption of normal distribution and significance level of 1-α, every deviation rate d corresponds to a return rate $r = d\sigma + \lambda$. Suppose the initial net asset of the guaranteed enterprise is W_0, its guaranteed loan is G, other debt total to z. Value of the discount rate of liquidation is $l = \dfrac{\text{liqudation value}}{\text{book value}}$, we have

$$VaR = |W_0 \times (d\sigma + \lambda)| \qquad (3)$$

If the future return is i.i.d. then VaR of different time periods is related to each other, and satisfying the relationship:

$$VaR_T = \sqrt{T}VaR \qquad (4)$$

4.1.3 Two-stage VaR-based pricing model

The existing absolute VaR method only considered the original debt risk, this section presents a two-stage pricing model of credit guarantee which considers both the original debt risk and the extended debt risk. (referred to [11]) When the enterprise in debt fails to pay back its debt to the financial institution, the guarantee institution should pay for the guaranteed enterprise. After that, the institution can get the recovery right, or ask the enterprise for bankruptcy liquidation, or extend the period to pay back. Therefore, for the institution, under the condition to ask for bankruptcy liquidation, the risk for the guarantee is only the risk of bank loan default, i.e. the original debt; under the situation to extend the payback period, the risk will also include deferred liability risk.

Suppose T_0, T_1, and T_2 are respectively the contract date, the due date of the original maturity, and of the evolving maturity of the debt. V_0, V_1, V_2 are respectively the value of the enterprise at T_0, T_1, and T_2. X_1, X_2 are the promised payback amount at T_1, T_2. When compensatory occurs, the guarantee institution gets corporate debt rights, value of C.

At T_1, under the significance level of 1-α, the potential loss of guarantee institution:

$$Loss_1 = \begin{cases} X_1 - C & if\ S_1 \leq X_1 \\ 0 & if\ S_1 > X_1 \end{cases}$$

We can calculate the minimum net asset of the enterprise is $W_0 - |W_0 \times (d\sigma + \lambda)|$, (where $|W_0 \times (d\sigma + \lambda)|$ is VaR of net assets yield of an enterprise.) The maximum loss of the guarantee institution is

$$LaR_1 = X_1 - C \tag{5}$$

At T_2, the potential loss of guarantee institution is

$$Loss_2 = \begin{cases} X_2 - S_2 & if\ S_2 \leq X_2 \\ 0 & if\ S_2 > X_2 \end{cases}$$

The minimum net asset of the enterprise is $W_0 - \sqrt{2}\ |W_0 \times (d\sigma + \lambda)|$. If the enterprise still cannot pay back the debt, it will announce liquidation, and its value is $(W_0 - \sqrt{2}\ |W_0 \times (d\sigma + \lambda)| + G + z)\ l$

Assume that after T_2, z remains the same, and calculate the total debt of the enterprise as $C(1+i) + z$ (i is the interest rate). Then the maximum loss of the guarantee institution is

$$LaR_2 = [C(1+i) + z - (W_0 - \sqrt{2}\ |W_0 \times (d\sigma + \lambda)| + G + z)\ l] \times \frac{C(1+i)}{C(1+i) + z} \tag{6}$$

Suppose that the probability of default at the first year is p_1, at the second year, it is p_2, then the expected maximum loss of the guarantee institution is $p_1 \cdot LaR_1 + p_2 \cdot LaR_2$

The income of the institution should be the sum of risk-free return and risk premium. The risk premium should be discounted to the initial period as:

$$risk\ premium = \frac{p_1 \cdot LaR_1}{1+r_f} + \frac{p_2 \cdot LaR_2}{(1+r_f)^2} \tag{7}$$

(r_f is the risk-free rate of return) If the magnification time is n, the corresponding risk-free return would be

$$\text{risk-free return} = 2r_f \cdot \frac{G(1+i)}{n} \qquad (8)$$

Therefore, at the first stage, the price of the guarantee should be:

$$P = \frac{p_1 \cdot LaR_1}{1+r_f} + \frac{p_2 \cdot LaR_2}{(1+r_f)^2} + 2r_f \cdot \frac{G(1+i)}{n} \qquad (9)$$

The corresponding rate of guarantee rate is $\ r_g = \dfrac{P}{G}$

Empirically, this method is adopted and tested to be close to the current guarantee rate in China. [6, 11]

4.2 Multi-stage VaR-based pricing model

In China, with the growth and maturity of the industry, the compensatory fee becomes the recurrent expenditure gradually. Consequently, it makes sense to consider deferred liability risk in the multi-stage situation.

Suppose the guarantee institution could be responsible for a guarantee period of m. At time $T_i (i = 1, 2, ..., m)$ the potential loss of guarantee institution is

$$Loss_i = \begin{cases} X_i - S_i & if\ S_i \le X_i \\ 0 & if\ S_i > X_i \end{cases} \qquad (10)$$

The minimum net asset of the enterprise is $W_0 - \sqrt{i} \,|\, W_0 \times (d\sigma + \lambda)|$. If the enterprise still cannot pay back the debt, it will announce liquidation, and its value is

$$(W_0 - \sqrt{i} \,|\, W_0 \times (d\sigma + \lambda)| + G + z)\ l$$

Then the maximum loss of the guarantee institution can be calculated as:

$$LaR_i = [C(1+i) + z - \left(W_0 - \sqrt{i} \,|\, W_0 \times (d\sigma + \lambda)| + G + z\right)l] \times \frac{C(1+i)}{C(1+i) + z} \qquad (11)$$

$$risk\,premium = \frac{p_1 \cdot LaR_1}{1+r_f} + \frac{p_2 \cdot LaR_2}{(1+r_f)^2} + ... + \frac{p_m \cdot LaR_m}{(1+r_f)^m} \qquad (12)$$

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$$risk\text{-}free\ return = mr_f \cdot \frac{G(1+i)}{n} \qquad (13)$$

Therefore, at the first stage, the price of the guarantee should be:

$$P = \frac{p_1 \cdot LaR_1}{1+r_f} + \frac{p_2 \cdot LaR_2}{(1+r_f)^2} + ... + \frac{p_m \cdot LaR_m}{(1+r_f)^m} + mr_f \cdot \frac{G(1+i)}{n} \qquad (14)$$

For $m > 2$ the guarantee rate $r_g = \dfrac{P}{G}$ would be larger than the two-stage model.

Correspondingly, at the stage of $i(<m)$, the price of the guarantee should be:

$$P = \frac{p_{i+1} \cdot LaR_1}{1+r_f} + \frac{p_{i+2} \cdot LaR_2}{(1+r_f)^2} + ... + \frac{p_m \cdot LaR_m}{(1+r_f)^{m-i}} + (m-i)r_f \cdot \frac{G(1+i)}{n} \qquad (15)$$

In general, the guarantee rate is increasing with the length of the guarantee period m. The intuition is similar to long-term loan or portfolio, as the time period could be regarded as a kind of risk. The above model provides a standard approach for the risk valuation of credit guarantee. The extension to multi-stage pricing reflects a more flexible credit guarantee market. However, the two-stage model is enough sufficient for the current credit guarantee market, which barely provides guarantee for SME for more than two periods. The accuracy of the multi-stage needs further investigations.

4.3 Credit Rating

In actuality, credit rating system directly affects the length of the period of the guarantee loans. One of the reasons that the guarantee institutions hesitate to provide long-term guarantee is that they lack a credible record of the SME.

Most other countries provide long-term guarantees of bank loans to SMEs, generally more than 2 years. The longest warranty period is 17 years. In contrast, in China, most guarantee loans are within the periods of six months, up to one year. The guarantee institutions are unwilling to provide guarantee sometimes, especially if the enterprise default at the first time, which will turn down some potentially successful enterprises. Building a rational credit rating system will be helpful.

On the one hand, rating assessment according to historical record provides guarantee institutions a reliable reference towards financing for the enterprise. On the other hand, SME borrowers will fear being denied further loans if they fail to repay, and hence try their best to enhance their performance. The following diagram concludes the credit factors:
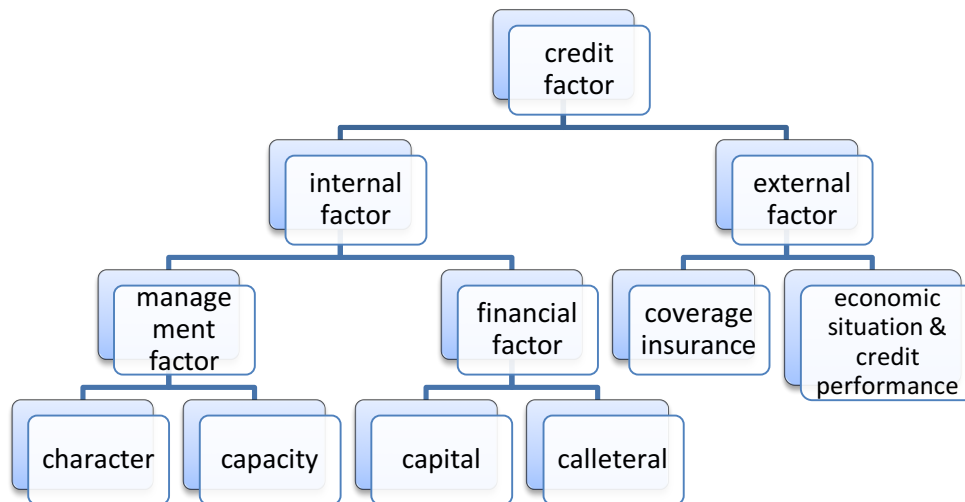

Figure 4.1: illustration of credit factors

All these factors decide the assessment of the guaranteed SME. Historical credit data are recorded to evaluate the SME, which is related to the level of credit risk. In this section, we will introduce a simple credit rating system, where historical credit data are used to select variables and weighting schemes.

Michel Dietsch (2002) [4] built two alternative models: the ordered probit model and a model which assumes a gamma distribution of the systematic factor. Firstly, classify SME credit guarantee by their credit quality. The credit evaluation is obtained by internal risk rating system of the bank. We assess the probability that the borrower will move to the "default class" over a given planning horizon.

Secondly, measure the likely exposure of each loan, and calculate the proportion of the exposure that would be lost if the borrower defaults. To capture the behavior of the portfolio as a whole, it is necessary to measure the correlations between losses. [4] Assume that exposures and default are independent. We concern the correlations

between defaults by measuring the volatility of PD (probability of default) in each risk class around its long-run stationary value.

Finally, according to the credit record of each SME, the guarantee institution or the bank should adjust their plans towards providing financing for the enterprise.

This section provides an outline of the first model, with the assumption of a normal distribution of the risk factors and a correlation between defaults. Each enterprise's default (or not) is determined by systematic risk factor and idiosyncratic risk factor. Define an unobserved latent random variable V as a linear function of the two factors: $V = \beta x + \varepsilon$, where x and ε stand for systematic risk factor and idiosyncratic risk factor respectively. Suppose $\phi(\ )$ is the standard normal CDF, the unconditional PD for a borrower belonging to a given risk class n is $\bar{p}_n$. Therefore, a borrower makes default when

$$\frac{\beta x + e}{\sqrt{1 + \beta^2}} < \phi^{-1}(\bar{p}_n) \tag{16}$$

Then we can compute the individual PD as: $p_n(x) = \phi[\sqrt{1 + \beta^2}\phi^{-1}(\bar{p}_n - \beta x)]$

The typical process and case analysis are discussed in detail in Michel Dietsch (2002) [4]. It is worth stressing the method to measure the volatility and correlations between losses. For a couple of corporations, a comparative approach could be used. Chi, Guotai, Yong Cao, and Libin Zhou[12] shed light upon the calculation of the correlation coefficient matrix utilizing the default distances (DD) and Gaussian copula function. Let Zi be the standardized latent variable of loaner i. For two enterprises i and j with the same rating grade, the covariance is given by:

$$\text{cov}(Z_i, Z_j) = E(Z_i Z_j) - E(Z_i)E(Z_j) = \frac{\beta^2}{1 + \beta^2} \tag{17}$$

The aggregate shocks result in the correlation, and the shape of the value distribution is skewed to the right, which is directly determined by the weight of the systematic risk factor β.

5 Conclusion and Policy suggestions

From the macro point of view, the government financial guarantee institutions dominate the SME credit guarantee system in China, which causes the low proportion of private capital guarantee institutions. Additionally, lack of proper supervision and interest rate control handicaps the development of the system.

The existing operating system defects also limit the demand in the credit guarantee market, exacerbate moral hazard and adverse selection, and hence affect the performance of the SME guarantee system and its sustainable development. The proposed pricing model based on VaR and the corresponding credit rating system (in section 4) is conducive to establish a standard method to charge SMEs for credit guarantee. Particularly, with the development of credit guarantee system and increasing demand for credit guarantee from SME, the extended multi-stage model would be applicable to accurately reflect the value of the credit guarantee. The paper proposed several policies as follows.

5.1 Institutions management

(1) Reasonable incentives and clear definition of the relationship between the guarantee agencies, the government, banks, and enterprises.

This includes elements such as the ratio of government funding for guarantee agencies, guarantee agency management operating mode, the reasonable sharing of risks between the lending bank and credit guarantee institutions, the proportion of credit guarantee, magnification, and guaranteed rates.

(2) Good collaboration between guarantee institutions and banks is one of the prerequisites for the successful operation of the guarantee system.

This suggestion is to reduce the moral hazard and adverse selection, mainly due to information asymmetry and distrust. Banks need an opportunity to learn more about SMEs, their problems, and their operations, to help improve their handling of SME loan

portfolios. It is also helpful to reduce transaction costs, which in return will increase the lending to SMEs. Only when the three participants keep in a good relationship, will the guarantee process be efficient, on the basis of mutual trust.
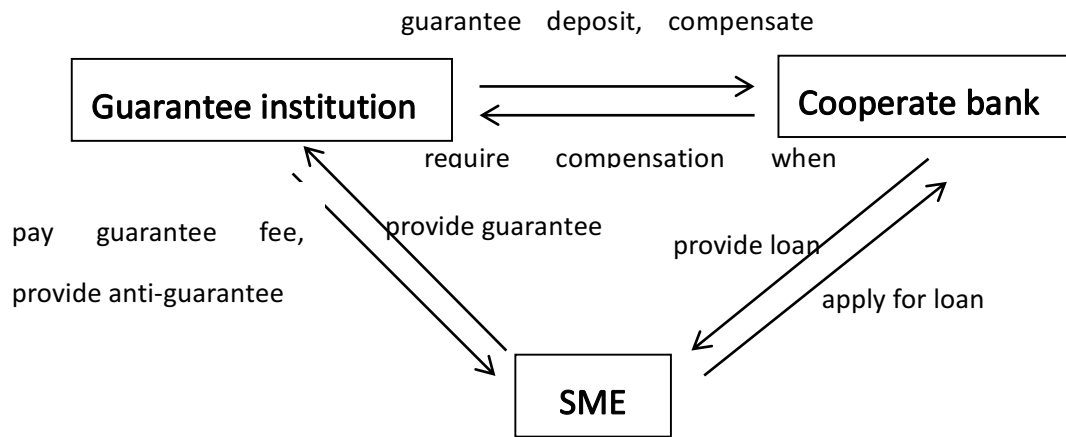

Figure 5.1: Relationship between guarantee institution, cooperate bank, and SME

(3) The broader scope of the guarantee business.

Guarantee institutions can learn from the strengths of foreign guarantee industry. They determine their main business and the direction of development and properly conducted guarantee business in accordance with the international trend, such as transfer of foreign exchange guarantee, contract performance guarantee, export guarantee, the customs tax payment guarantee, guarantee, etc.

(4) Introduction of professionals.

The improvement of SMEs credit guarantee also depends on the standardized management and operation. They are responsible for analyzing the performance of the SMEs, commanding the market supply and demand, and managing a business in line with national industrial policy and standards.

(5) Risk prevention—pricing and credit rating.

As shown in section 4, building the standard pricing and credit rating system is necessary to regulate the guarantee business. The establishment of credit rating system

as a supportive measure creates effective incentives by keeping track of credit records, which is advisable to limit the SMEs that could be guaranteed. They can also take measures to strengthen SMEs risk liability, such as mandatory anti-personal property collateral, in order to constrain the conduct of operations managers.

5.2 Government management and market mechanism

It is significant for the government to manage the fine line between support and control, encouragement and interference.

(1) Expansion and development of the commercial guarantee institutions.

The government funding is indispensable to the success of credit guarantee in any country. However, a soft budget constraint problem handicaps its growth and efficiency. It should be subjected to extensive supervision for budgets like, how much could be invested for guarantee institutions every fiscal year. In addition, it is recommended to reduce the proportion of the government guarantees in the whole security system and to increase the proportion of mutual guarantee and commercial guarantees to secure private capital in the entire security system.

(2) Improve the re-guarantee system, improve risk diversification mechanism.

The gradual establishment of re-guarantee institutions effectively disperses guarantee risk. At the same time, the re-guarantee institutions can transfer their risks through gaining guarantee from the other re-guarantee institutions. Moreover, we need a government compensation mechanism, which includes managing the size and degree of dispersion of SME guarantee fund.

(3) Active and innovative forms to develop credit guarantee career.

To promote SME development, a liberalized interest-rate regime is preferable. In that case, the market forces will determine the cost for any borrower according to the relative credit risk. We also expect more innovative forms to build a sustainable credit guarantee system, and to improve the market competitiveness globally.

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