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Research Article

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Design of dynamic counter-guarantee reserves of loans to SMEs*

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ABSTRACT

The small and medium-sized enterprises (SMEs) often need guarantee companies to guarantee the loan from banks, and the guarantee companies undertaking the businesses require SMEs to provide counter-guarantee. How should counter-guarantee risk reserve be paid? And how much should enterprises pay? There is a lack of relevant research at home and abroad. This paper builds dynamic counter-guarantee model in a guarantee system of the bank - guarantee company - SME cooperation with government support. According to the size of enterprises' business risk , the counter-guarantee risk reserve is dynamically adjusted. When business risk increases, enterprises are required to increase risk reserve in the account; when business risk reduced, enterprises can extract excess reserve. Dynamic counter-guarantee reserve can be used to control bank loan credit risk, solid guarantee system, and help to solve the financing problem of SMEs.

Keywords: SME counter-guarantee dynamic risk reserve

INTRODUCTION

SMEs is an important part of the national economy, and is irreplaceable to promote economic and social development of our country, which can with stimulate growth, creat jobs, boost innovation and so on. However, SMEs themselves are so short of credit that banks are reluctant to loan to them, which is also a universal challenge.

To solve this problem, domestic banks generally require borrowers to mortgage their own real estate or other property. In addition, the guarantee of SME financing guarantee institutions is also required. For banks, after guarantee of financing guarantee institutions, its exposure to risk decreases because the second source of repayment of the debt is introduced. However, is there no risk at all if financing guarantee institutions guarantee the loan? [1]If the borrower defaults and the bank terminates the contract, the financing guarantee institution is often required to assume liability of repayment first so that the bank is able to save the cost. And according to relevant provisions in China's laws and regulations, after guarantor fulfill guarantee obligations and the creditor get repaid, the mortgage shall be eliminated, and therefore the guarantor is not entitled to claim the priority of original collateral; Also, if the borrower bears debt to creditors other than the financing guarantee institution, the financing guarantee institution can only claim with others with equal liquidation status, and maybe it will get nothing, which undoubtedly makes the financing guarantee institution face great risk and therefore limits enthusiasm of the financing guarantee institution to provide guarantee for SMEs. So guaranteed enterprises or a third party are usually required to provide counter-guarantee.

The so-called counter-guarantee is that the third party who guarantees for the debtor require the debtor to provide a guarantee in order to ensure the realization of the right of recourse. When debt expires and the debtor does not pay back money but a third party assumes it, the third party then become a creditor of the debtor and has the right to have recourse against the debtor. When the third party exercise the right of recourse, the debtor maybe have no ability to repay; hence, in order to ensure the realization of the right of recourse, the third party can require the

debtor to provide guarantee. And the guarantee that debtor in turn provides for the creditor is called the counter-guarantee.

Then, how should the counter-guarantee risk reserve be paid? The previous research of the project gives a solution to build a guarantee system of the bank - guarantee company - SME cooperation with government support and simulate mark-to-market system of futures to set the counter guarantee risk reserve. How much should the counter-guarantee risk reserve be? Too much reserve will burden SME too much, and even far beyond its capacity; but too little reserve is not able to control the risk. How much on earth should the appropriate counter-guarantee reserve be set aside is the problem to be solved in this study.

2. Research Review

Last three decades, foreign researches on post-loan credit risk management have mainly focused on financing guarantee. The main representative of new Keynesian, George A. Akerlof (1970) in his famous paper, "The Market for Lemons": Quality Uncertainty and the Market Mechanism," gave the consequences of asymmetric information and pointed out that guarantee was one of the effective mechanisms to eliminate asymmetric information. The primary problem of guarantee is how to price it. Samuelson (1970) first proposed guarantee pricing, and then Merton (1973) and others' put option pricing model had a profound impact. Jones and Mason (1985) built loan guarantee pricing model with no risk guarantee using the continuous-time model. San-Lin Chung (2006) constructed a model of a company guaranteeing several loaning enterprises using option pricing method in the case of stochastic interest, and discussed the impact of important parameters of loan companies, guarantee agencies on loan guarantee pricing in Monte Carlo simulation method. In domestic researches, earlier research on credit risk management through credit guarantee was Mei Qiang's study (2002), which made a thorough analysis of the possible compensatory rates and recovery rates under different guarantee charge rates, and thought that guarantee charge rates can be deduced according to different compensatory rates and recovery rates. Chen Xiaohong, etc. (2005) proposed to build the system of SME credit guarantee, mutual guarantee institutions as the main while policy guarantee institutions and commercial guarantee institutions as the complement, and proposed pricing guarantee using VaR model[2]. Liu Xiangbin (2010) further emphasized that SME financing guarantee had both policy and financial characteristics, and pointed out that some guarantee companies had low solvency, so in the event of business compensation, their own survival will be directly affected, and that guarantee industry overcharged also seriously affected its business development.

As to researches on specific application of the counter guarantee, Xu Youchuan, Yang Jiguang (2008) researched on credit guarantee option pricing considering counter-guarantee provided by a third party in the paper credit guarantee option pricing based on a third party providing counter-guarantee. But no article studied on the setting up and computation of counter-guarantee reserve.

3. Counter-guarantee Model

To simplify the problem most, consider that a company of total value V_A obtains bank loans by way of a guarantee company and should repay the value of K at maturity. If the value of the company at maturity exceeds K, then the loan will be fully repaid. However, if it is less than K, then the company will default, and the guarantee company will have to repay the loan K instead but can only get V_A, and the stock value will become zero. In this process, we assume no transaction costs.

Therefore, the market value of equity at maturity is $V_{ET} = Max(V_{AT} - K,0)$

Because the market value of the company is the sum of the loan and equity, the value of the loan $L_T = V_{AT} - Max(V_{AT} - K\ ,0) = Min(V_{AT}, K)$ Assuming the value of its assets follows a geometric Brownian motion:

$$dV_A = \mu V_A dt + \sigma_A V_A dz$$

μ and σ_A are drift and volatility of changes in value of the company.

The market value of equity can be deemed the value of call option of the company's assets.

According to the Black-Scholes option pricing model, the equity value at time t can be rewritten as

$$V_E = V_A N(d_1) + e^{-rt} LN(d_2)$$

V_E is market value of equity
L is the carrying value of liabilities at maturity
r is risk-free rate

$\tau = T - t$ is the expiration time of the loan

$N(\mathrm{d}_1)$ and $N(d_2)$ are standardized cumulative normal probability density function

$\mathrm{d}_1 = \frac{\ln(\mathrm{V/Ke}^{-r\tau})}{\sigma\sqrt{\tau}} + \frac{\sigma\sqrt{\tau}}{2}, d_2 = \mathrm{d}_1 - \sigma\sqrt{\tau}$ In Merton model, $N(d_2)$ is the probability that the call option is still in the money at maturity, and the probability that default will not occur. So, in turn, 1- $N(d_2) = N(-d_2)$ represents the probability default will occur.

In practical application, we substitute volatility of the company value V_A for the volatility in BS model, that is, $\sigma = \sigma_{V_A}$. Here, we can observe the market value of the equity, stock value V_E and the stock volatility σ_{V_E}, and then you must deduce the company value V_A and its volatility so that they can be plugged into the formula. $\Delta = \mathrm{N}(\mathrm{d}_1)$ is defined as the hedge ratio, and we get:

$$\mathrm{dV_E} = \frac{\partial V_E}{\partial V_A}\mathrm{d}V_A = \Delta \mathrm{d}V_A$$

$\sigma_{V_E} = \mathrm{d}V_E / V_E$ is defined as the volatility, and we get $\sigma_{V_E} = \Delta(\sigma_{V\,A} V_A)$, and then we know $\sigma_{V_A} = (1/\Delta)\sigma_{V_E}(V_E / V_A)$

In which，

$$\sigma_{V_E} = \sqrt{\frac{1}{\mathrm{n}-1}\sum u_t^2 - \frac{1}{\mathrm{n(n\text{-}1)}}(\sum \mathrm{u_t})^2}$$

and， $u_t = \ln(V_{E\,t} / V_{E\,t-1})$

From L=V_A-V_E， we know

$$\mathrm{L} = \mathrm{Ke}^{-r\tau} N(d_2) + V_A[1 - N(d_1)]$$
$$L / Ke^{-r\tau} = N(d_2) + (V_A / Ke^{-r\tau})N(-d_1)$$

At maturity, the credit loss is the value of risk-free bonds minus the value of the loan, $CL = B_F - B_T$, expected credit loss (ECL) is as follows:

$$L_F e^{-r\tau} - L = Ke^{-r\tau} - \{\mathrm{Ke}^{-r\tau} N(d_2) + V_A[1 - N(d_1)]\}$$
$$= \mathrm{Ke}^{-r\tau}[1 - N(d_2)] - V_A[1 - N(d_1)]$$
$$= \mathrm{Ke}^{-r\tau} N(-d_2) - V_A N(-d_1)$$
$$= N(-d_2)[Ke^{-r\tau} - V_A N(-d_1)/N(-d_2)]$$
$$ECL_T = N(-d_2)[Ke^{-r\tau} - V_A N(-d_1)/N(-d_2)]$$

The formula includes two terms, the first is the probability of default $N(-d_2)$, and the second is the loss of default, $Ke^{-r\tau} - V_A N(-d_1)/N(-d_2)$, and that is also the company's expected value in default state. Note that the recovery rate here is endogenous, since it depends on the company's value, time and debt ratio.
The amount in the counter-guarantee account should be ECLT

ECLT can also be decomposed into: ECLT = $Ke^{-r\tau} - \{\mathrm{Ke}^{-r\tau} N(d_2) + V_A[1 - N(d_1)]\}$

$$= -V_A N(-d_1) + \mathrm{Ke}^{-r\tau} N(-d_2)$$

To control risk, the risk reserves in the account in which SME financing guarantee institutions require guarantee companies set aside should be the expected credit loss ECLT[3] .

Assuming SMEs get bank loans by guarantee companies, and the initial value is K0 and the value at maturity is K, and guarantee companies require guarantee fee of C (guarantee fee equals basic guarantee fee which is cost of guarantee company plus the company's profits), meanwhile, guarantee companies require the companies to set up counter-guarantee accounts to control risk, and the amount is $-V_A N(-d_1) + \mathrm{Ke}^{-r\tau} N(-d_2)$

Determination of company value V_A

The determination of company value V_A is divided into two situations: First, if the company is a listed company, the value of the company can be reflected by the share price[4]; Second, if the company is an unlisted company, company value can be "marked to market" by some financial indicators, for example, EBIT. You can get it by the company's quarterly financial statement, and then calculate multiplier V_A /EBIT by average amount of comparable companies or industry, and then get V_A , and control risk by put the amount $-V_A N(-d_1) + \mathrm{Ke}^{-r\tau} N(-d_2)$ into reserve account.

4. Case Analysis

Suppose A company valued 400 million yuan with annual fluctuation rate of 20%, and risk-free interest rate was 3%. Suppose Company A got a two-year loan of 2000000 yuan at maturity from Bank C via Guarantee company B. In addition, the guarantee company charge 3%.

Using the above Merton model for counter-guarantee, calculate reserves in counter-guarantee account with the change of company value and time, see TABLE I below.

Table 1. rsserves in the account

Company value	4000,000	4050,000	4070,000	3500,000	3000,000	2500,000	1900,000	2000,000
Residual maturityτ	2	1.75	1.5	1.25	1	0.75	0.5	0.25
Reserves	712.82	807.67	2867.99	567.22	2588.75	12515.13	146791.9	72107.38

Because there exists risk in company operation, the company value is not static. Here, it is assumed that in the course of a two-year loan period, company operating at the beginning was in good condition, but then in a loss, and after one year and a half, the company was in so heavy a loss that company value was even slightly lower than value of the loan value. From the above table, it can be seen that with the remaining period decreased on a quarterly basis (0.25 years), the company value first increased and then decreased. When the company value was far more than the loan amount, the required reserves were low; With maturity date approached, the closer the loan value was to the company value, the higher reserves were required; If the company value was less than the loan amount, the required reserves would be greatly increased, in order to guard against the risk of insolvency.

CONCLUSION

This paper studies using counter-guarantee to control the entire system risks in a guarantee system of the bank - guarantee company - SME cooperation with government support when SMEs apply for loans from banks. The dynamic reserves simulate futures' mark-to-market system to control credit risk assumed by banks after loans. This

research will effectively resolve the problem of banks' reluctance to lend to SMEs, and thus help to solve the financing problem of SMEs.

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