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RESEARCH PAPER

Loan Rate Pricing of SME Financing based on Agent-based Computational Finance Approach

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Abstract: From the perspective of Chinese commercial banks' loan pricing, combined with credit rationing theory, using the method of agent-based computational finance(ACF), to do the bank loan's simulation experiment both on "one cutting" type of interest rate pricing and a comprehensive pricing model. From the comparison, we found that the different interest rates pricing model impact SMEs loan. From the experimentwhen the loan interest rate raise to a certain extent, the earning of bank will reduce accompany by the increasing of interest rate, to some extent, reflecting the credit rationing phenomenon of SMEs(Small and Medium Enterprises). Through the experiment we found that the comprehensive loan interest rate pricing method slow down their financing difficulties, and they also don't reduce bank's earning. So the commercial banks should choose a reasonable interest rate pricing model, according to the loan amount, credit grade, asset-liability ratio, the way of security, and other indicators, according to the risk of small, low cost, and the specific circumstances of the borrower companies, to implement different interest rate.

Key words: SME loan; agent-based computational finance; loan pricing; credit rationing

1 Introduction

Since 2008, there have been some new circumstances that exert great influence on SME's operation and financing as the economic developing during the American subprime mortgage crisis. The difficulties of financing are the biggest bottle-neck for the developments for SME. The growth of SME will be possible, only when the financing problems of SME, which are the "short boards" for them, are relieved. At present, most of our banking financial institutions still evaluate SME loans by referring to the indicators and the standards for the big-sized enterprises. Some decisions are based on subjective judgments and the price was just by simply adding a point or multiplying a coefficient. Because there is no mature and feasible pricing system, the pricings are too low to cover the default risk of SME, or too high to aggravate the cost of SME.

The focus on the difficulties of SME loans is the difference between SME and banks over the interest rates. 2007, the report of "the investigation and research of the rural finance and the financing of the small enterprises" held by banking research center of central university of finance and economics showed that 80.4% of financial institutions regulated the interest rate up to more than 10%. Among them, there were 24.8% financial institutions regulated the interest rate up to 50 % more, and there even were 5.9% of financial institutions regulated the interest rates three times of basic rate which was a very strict qualification. There were 40% of enterprises that wished the loan rate level was the basic rate, 30 percents of enterprises could get the banking loans at the rate from 1.1 to 1.3 times of the basic rate. There were only 0.13% of the enterprises that would accept the rate regulated by some financial institutions, which is three times of basic rate. Thus, there are great divergence between the loan office and the credit side on the problem of loan interest rate. So it is very urgent to solve the interest rate problem to relieve the loan difficulties of SME under the present circumstances. Moreover, the key is to confirm the reasonable pricing standards.

There are extremes of the loan pricing of SME from the practical condition. One is that the pricing is too low to reflect and cover the default risks of SME, the other is that the pricing is too high. Because most SME are using the mortgage and assurance, which need many procedures such as register, assurance, notarization, and even insurance, aggravating the cost of SME. So the research of the loan interest rate pricing in loan financing of SME has very practical meaning for the relief of the "tight-loans" of the commercial banks to SME and the acceleration for the development of SME in our country. The basic principle is the symmetry of the risk and benefit from the view of the operation of financial market. The extension of the upper limit for the loan interest rate will make the acquirement of the loan more important than the higher interest rate for SME. And the risk level of SME is pretty high, in general. If the banks are forced to

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provide a lower loan interest rate for SME, the benefits of the financial institution will not be able to cover the risks. Naturally, the financial institutions will remarkably decrease the financing for SME, which will lead to striking drop of the acquirements of loans for SME. Thus, the preferential loan interest rate for SME that aims to support the financing of SME, actually restrains the abilities of SME to acquire the loans from financial institutions.

With the deepening of market-oriented interest rateupper limit of the loan rate has been relaxed, and the right to loan pricing has been transferred from the central bank to commercial banks . This has increased the flexibility of the loan, and enhanced flexibility of commercial banks for corporate loans with different risk characteristics, from different industries and of different scales. The study of this change's impacts on SME financing is rare.

In the context above, main issues of this study can be summarized as two points: First, after the relaxation of interest rate control, commercial banks have a certain right of the interest rate pricing. How to price a reasonable interest rate in response to high-risk SME and how to alleviate the plight of SME financing without reducing their earnings? Second, after determining the commercial bank loan rate pricing model, what kind of impact has been brought to the bank benefits and SME financing by changes in a number of factors? Furthermore, we could provide policy recommendations about banks' pricing process.

For a long time, domestic and foreign scholars have carried out extensive researches about the problem of commercial bank loan pricing. AndrewHChen[1] had a conclusion that the cost of the contract has an impact on the loan pricing , and the credit spreads depend on the costs of the bank's internal supervision of loans. Corvoisier and Cropp's[2] model has demonstrated that the loan pricing depends not only on the deposit interest rates, operating costs, and other factors, but also on the number of banks in the market. Under the other variances controlled, the improvement of the market concentration will raise the bank's loan pricing. Considering that the bank's loan is differentiated products, borrowers need to pay a certain amount of switching cost, when shifting to another bank. After putting the switching cost into the model, the analysis of the bank's loan behavior is much closer to reality. In the process of measuring the risk of SME loan, Dietsch and Petey[3] have done not only the calculation of the single loan's default probability and the amount of risk exposure, but also how to measure the portfolio risk, and calculated the correlation of the default. Assuming a constraint condition that banks' economic capital Kp is equal to a given amount of V, loan rate should depend on the returns of target capital, the loan amounts, the risk-free interest rate, the additional amount of economic capital, the loan recovery rate, the default probability, and other factors.

With the deepening of market-oriented interest rate in China, domestic scholars have referred to western commercial bank loan-pricing method, and made a loan interest rate pricing model appropriate for China. Based on the maximum principle, Zhuang Xin tian and Huang Xiao yuan[4] studied the bank's loan-pricing strategy in the condition of information asymmetry, and then established a relevant pricing model; Li Rong-zhou with his colleagues[5] have studied that under the condition of the information asymmetry, the changes of the loan rate and the enterprises' defaulting repayment probability have the impact on the bank's expected profit when enterprises are seeking opportunity profits. Zhang Wei and Qiu Yong[6] had an analysis of the features of a special portfolio contract, called Multi-bank loan pool for small businesses. Pang Su lin and Wang Yan ming[7] described a credit decision contract, that contained a loan interest rate, hypothecated goods and a ration as a credit decision contract which contained a default probability, and created a credit decision model including default risk parameter, then got a relevant credit decision mechanism and a credit decision mechanism without rationing loans. He Zi li[8] did an analysis of economic returns and risk from loans for SME, then studied the relationship between the level of SME loan rate, the cost, and the risk-adjusted earning, finally concluded that the cost of SME loan and the risk-adjusted earning should be higher than the level of other quality loans' recommended rates.

But the factors that the research above refers to, adverse selection, moral risk, regulation, ownership structure, information environment, firm size and so on, may change the acquisition of loan. Clearly, if we consider all or most of the factors at the same time, the difficulty of derivation of analytical model will rise. We can't even obtain the analytical solution. Based on the earlier analysis, if we can find new research methods and means in methodology level, and design model to solve the difficulty of SME loan for the balance between bank and firm. Carry out numerical and analytic analysis and take advantage of the data from simulation model to study the theory of the difficulty of SME loan in our market, then it will contribute to the solution of the difficulty of SME loan.

The rapid development of agent-based computational finance(ACF) in middle and late nineties of last century provides us a brand-new method, which searches for the law displayed in the interaction between agents by dynamical simulation. In this area, the main related researches domestically and abroad are as follows: Miriam Goldberg etc. from Santa Fe institute designed a simulation model for micro finance, also carried out simulation for eight-group strategies, which is constituted of three personal action strategies in group loan in rural areas, and then pointed out the importance of group outside study, taking further consideration of the influence of policy to loan. Besides, Thomas H. Noe with his colleagues simulated the economy system, which is composed of adaptive individuals to test and verify the financing options of firm. This is a good application of dynamical learning mechanism in economy field. Massimo Sapienza established a Swarm simulation model for bank network, and carried out experimental research about spontaneous emergence of media activities in finance. Based on the CAS(Complex Adaptive System) theory, Xuebin Chen etc. analyzed the features of two kinds of agents as owner and operator of commercial banks and the behavior mode depicted as self-utility maximization in choosing contracts and distributing profits. They simulated the behavior progress in SWARM platform to observe the results in different incentive constraints.

The literatures mentioned earlier supply a great idea for analyzing the relationship between banks and firms. But us-