

Research Article

An Incentive Mechanism Model of Credit Behavior of SMEs Based on the Perspective of Credit Default Swaps

Shenghong Wu,¹ Pei Mu,¹ Jiaxian Shen,¹ and Wenyi Wang ²

¹School of Economics and Management, Nanjing Tech University, Nanjing, China

²Department of Social Sciences, University of Toronto, 1265 Military Trail, Toronto, ON, M1C 1A4, Canada

Correspondence should be addressed to Wenyi Wang; wenyi.wang@mail.utoronto.ca

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The rapid development of credit default swap (CDS) market has changed the manner of credit risk management of banks to some extent and has had a new influence on the bank-enterprise credit model. In this study, the credit financing process of credit risk in small- and medium-sized enterprises (SMEs) gathers within a bank, which makes it difficult for SMEs to raise funds. On the basis of the perspective of CDS, we construct an incentive game model of bank-enterprise credit behavior and analyze the influence mechanism of the credit financing of SMEs on CDS contract coupon rate, CDS payout ratio, bank-enterprise credit effort, and loan recovery rate when considering CDS. The result shows that the CDS contract leads to insufficient supervision after a bank loan, the moral hazard of the SMEs rises, and the probability of credit default events increases. In addition, in view of CDS, the SMEs can access more credit funds.

1. Introduction

Under the background of the development of the new normal of China's economy, the development of small- and medium-sized enterprises (SMEs) is related to the realization of economic structure transformation, economic benefit growth, and economic quality improvement. On the one hand, the stable development of SMEs is the necessary condition to support the efficient operation of a real economy. On the other hand, SMEs are characterized by large number, large thrust, and great potential, which play an important role in promoting employment, improving people's livelihood, and increasing tax revenue [1]. As an important part of private economy, SMEs not only create over 75% of urban jobs and over 60% of gross domestic product but also contribute to over 50% of the national tax revenue. In addition, 65% of invention patents and 80% of new products in scientific and technological innovation are developed by SMEs. Party in 19 major reports clearly indicated that to "support the development of private enterprises and stimulate the vitality of various market entities."

Therefore, the manner in which high-quality development of SMEs can be promoted gives full play to the role of SMEs as a new force in the economy, and the government should focus on practical issues. However, in the high-quality development of SMEs, the first "obstacle" to be solved urgently is the "financing difficulty" of SMEs. At present, scholars at home and abroad have mainly discussed the financing mode of SMEs from the perspectives of bank competition, bank-enterprise relationship, and bank development, mainly including the following. (1) The market competition between banks can improve the financing efficiency of regional credit market, which has a certain positive influence on improving the availability of credit funds for SMEs, and help SMEs obtain more loan resources [2, 3]. In addition, the concentration of the banking market has increased the credit supply to SMEs. For SMEs with more opaque information, greater risks, and greater dependence on external financing, adverse market forces will have a stronger effect [4]. (2) SMEs not easily acquiring credit financing is one of the main reasons for the information asymmetry between banks and enterprises; therefore, SMEs can establish good cooperative

relations with banks to reduce credit friction, which helps reduce the cost of credit financing and enable a smooth acquisition of bank loans [5, 6]. At the same time, some scholars have discussed how information asymmetry between banks and enterprises affects the financing decisions of SMEs based on agency theory [7]. (3) Cash flow is an important factor that affects business investment, and the bank's development can effectively enhance enterprises' cash flow and ease the financing constraints of SMEs. Second, in terms of research methods of SMEs' credit, Tian et al. [8] explore whether and how the geographic distance between VC institutions and enterprises influences the enterprise's technological performance from the perspective of the VC's equity backgrounds (governmental, private, and foreign) and investment strategies (independent and joint). Othman and Maisyarah [9] used statistical methods of regression analysis to analyze the effects of microfinancing or micro-credit services on the performance of Malaysian micro-enterprises. They mainly evaluated basic financial elements, such as financing or loan term, collateral, financing margin, and repayment method. The authors believed that these financial services have important effects on the operation performance of microenterprises. Baker et al. [10] studied the financing preference of these SMEs by using the survey data of 309 SMEs in northwest India, and the respondents indicated that they preferred internal financing sources, followed by bank financing, long-term loans, and funds from the government and financial institutions. The current study provides SMEs' owners and managers with an overall view of financing sources, which not only helps SMEs identify underutilized financing channels but also provides policy makers with an effective data source for formulating reasonable fiscal policies. Given that innovative SMEs face many obstacles when entering the credit market, Yu et al. [11] showed that the credit index system constructed provides a comprehensive and systematic model for evaluating the credit of TSMEs in China. Silvia and Sebastiano [12] proposed a multistandard credit rating model to obtain financing for innovative SMEs and obtain risk grade allocation data for SMEs. However, many factors affect bank credit decisions, such as controlling credit default risk, preventing hidden risks within the system, bank capital adequacy ratio, and liquidity risk [13]. Therefore, to solve the "financing difficulty" problem of SMEs, banks' risk-bearing problem must also be solved to some extent. Thus, when discussing the financing problems of SMEs, we should pay attention to whether excessive credit risks will accumulate in banks due to lending and seek methods that can help banks release and disperse credit risks. In addition, combining with the characteristics of financing of SMEs, we should attempt to find a way to solve the financing difficulties of SMEs, which is also the key content of the present study.

With the rapid development of various financial instruments and credit derivatives, credit default swap (CDS) is gradually becoming an important risk-sharing channel in the credit process of SMEs [14, 15]. Generally, CDS trades both parties consisting of credit to protect the buyer and seller credit. CDS has a duration; within this duration, the buyer pays the seller on a regular basis. If the default event

does not take place in the agreement, then the contract will expire without compensation behavior. In case of default, the credit default of the buyer can obtain damage from the seller. In theory, CDS contracts have changed the way in which banks bear all credit risks in the past by taking credit risk away from banks through market transactions. On the premise of not changing the relationship between the parties to the original debt contract, the default risks of some nonperforming loans can be transferred, which can reduce banks' credit risk exposure. Thus, the risk hedging function of CDS not only changes the loan default risk massive accumulation of bank internal situation but also conduces banks to increase liquidity [16] and release adequate loan funds to meet the loan demand of SMEs. Therefore, banks can hedge credit risk by doing business with CDS counterparties and by buying CDS that transfer credit risk to CDS sellers. For SMEs, which will also improve their financing difficulties, the possibility of SMEs obtaining bank credit funds increases. In practice, banks often require SMEs to provide physical mortgage and third-party guarantee to prevent the default risk of loan enterprises [17]. However, SMEs have a small operation scale, limited fixed assets, and insufficient loan collateral; thus, they have difficulties meeting the requirements of banks to avoid risks [18]. Therefore, when some loan enterprises lack collateral or credit qualification, some scholars have proposed the development of credit guarantee by third-party guarantee institutions to provide them credit guarantee to increase the possibility of a smooth acquisition of a loan credit [19]. When the borrowers default, the guarantee institution assumes joint and several repayment liabilities, thereby protecting the banks' interests. However, at present, most of the guarantee institutions have insufficient funds to meet the guarantee needs of many SMEs. In addition, SMEs lie about the financial truth and camouflage their financial statements; thus, agencies cannot understand the actual operating conditions of SMEs, which not only increases the operational risks of third-party credit guarantee institutions but also make gaining the trust of banks and maintaining a stable bank-enterprise financing relationship difficult for guarantee institutions. On this basis, vigorously developing CDS products is of positive practical significance and urgency, considering the manner in which banks' enthusiasm for lending to SMEs can be enhanced and the problem of SMEs' lack of loan collateral can be solved.

CDS not only optimizes the financing environment of SMEs but also brings the negative effects of SMEs' credit behavior [20]. On the one hand, banks use CDS contracts to disperse credit risks and transfer them outside of the banking system. In this manner, not only can banks reduce risk losses effectively but also make them reduce costs and minimize their supervision and audit of loans, which will increase the credit default probability of incidents and banks' moral hazard. On the other hand, some SMEs take advantage of the supervision negligence of banks to apply for loans, which leads to the situation that banks delegate loans to SMEs whose credit rating is not up to standard and whose underlying assets are not up to standard. Another situation is that after SMEs apply for a loan, their operating efforts are

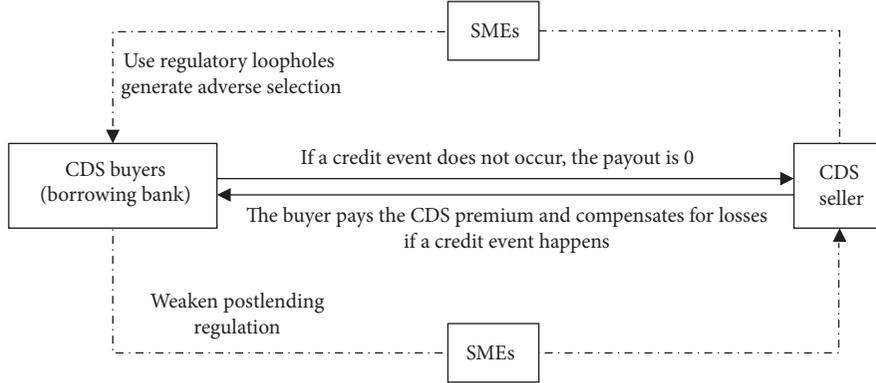


FIGURE 1: Credit financing mechanism of SMEs under the influence of CDS.

declined, and they do not invest in accordance with the provisions of the credit contract. This phenomenon is the problem of adverse selection of SMEs, as shown in Figure 1.

On the basis of the above analysis, banks are more willing to establish a credit contract relationship with large enterprises with excellent qualifications and strong solvency after measuring factors, such as capital safety, loan cost, and maximization of economic benefits. Conversely, SMEs have difficulty in obtaining bank credit due to low credit, insufficient guarantee, and incomplete financial information disclosure. If the traditional lending relationship can be changed and risk transfer approaches can be used to disperse the credit risk of SMEs or increase the capital adequacy ratio of banks and reduce the liquidity risk of banks, then the financing environment of SMEs can be improved, and CDS will become a practical and effective approach to disperse credit risk [21]. Therefore, given the incompleteness of SMEs' credit contracts, this study introduces CDS and establishes a game model of bank-enterprise credit behaviors with CDS mechanism. It also discusses SMEs' credit behaviors from the perspective of CDS and provides new theoretical guidance for improving SMEs' financing difficulties and alleviating banks' credit risks.

The structure of this article is organized as follows. In Section 2, an incentive mechanism model of CDS's influence on bank credit behavior is constructed and analyzed. In Section 3, we mainly discuss the incentive mechanism model of CDS's influence on credit behavior of SMEs. Section 4 provides the concluding remarks of the study.

2. Incentive Mechanism Model of CDS's Influence on Bank Credit Behavior

2.1. Model Assumptions

Hypothesis 1. SMEs apply for a certain amount of loan m from the bank to meet their development needs, and the loan interest rate is r . Within the credit contract period of banks and enterprises, the probability of the occurrence of credit default is p ($0 \leq p \leq 1$), and the probability of the nonoccurrence is $1 - p$. In the event of a credit default, the recovery of the underlying asset is ω ($0 \leq \omega \leq 1$).

Hypothesis 2. To prevent credit default, a large number of loan default risk internal agglomeration, and cause systemic risk in banks, banks buy CDS to transfer credit risk. Assume that the coupon rate of the CDS contract is C , the CDS loss rate is e ($0 < e < 1$), and the CDS seller pays Q when the underlying asset defaults. If the bank does not trade CDS, it has to bear all of the loan default losses. Therefore, the policy selection space of the bank can be expressed as $S = \{\text{Buy, Don't buy}\}$.

Hypothesis 3. The audit cost of SMEs before lending and the supervision cost after lending are recorded as the bank's effort cost $(d_2/2)\theta_2^2$, $d_2 > 0$ is the bank's effort cost coefficient, and θ_2 ($0 < \theta_2 < 1$) is the bank's effort level. Given that banks can transfer credit risk through CDS contracts, they have an incentive to relax the pre- and postloan regulations of companies to reduce credit costs and meet the demand for profit maximization. Therefore, we assume that the bank's effort function is $f(\theta_2) = e \cdot (d_2/2)\theta_2^2$.

2.2. Model Construction and Analysis. On the basis of the trading mechanism between banks and CDS sellers and the above assumptions, whether a credit defaults or not, the bank's income status based on the CDS contract can be represented by the game tree in Figure 2.

As shown in Figure 2, on the basis of the game model of the bank's credit selection strategy, the expected return of the bank when buying CDS products is

$$E_b = p \left[(r - C - \omega)m + Q - e \cdot \frac{d_2}{2} \theta_2^2 \right] + (1 - p) \left[(r - C)m - e \cdot \frac{d_2}{2} \theta_2^2 \right]. \quad (1)$$

At the same time, the expected return when the bank does not buy CDS products can be obtained as follows:

$$E_n = p \left[(r - \omega)m - \frac{d_2}{2} \theta_2^2 \right] + (1 - p) \left[r \cdot m - \frac{d_2}{2} \theta_2^2 \right]. \quad (2)$$

In actual transactions, banks will only choose to buy CDS if and only if the yield of the bank buying CDS is greater than

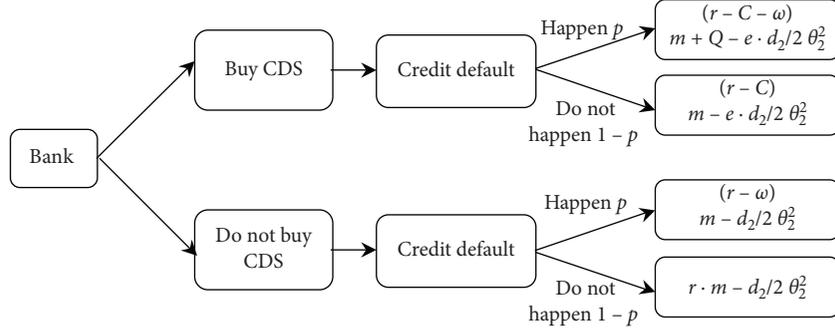


FIGURE 2: Game expansion of bank selection strategy.

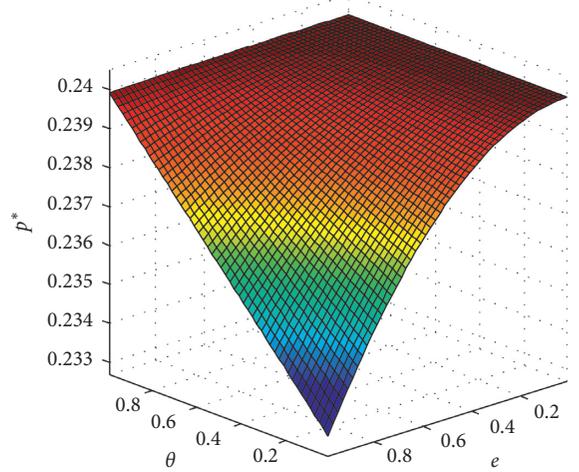
or equal to the yield of the bank not buying CDS, namely, $E_b \geq E_n$. That is, the equilibrium condition of the bank's strategy selection will be realized only when the bank gains the same income under the two selection strategies of buying or not buying, namely, $E_b = E_n$. At this point, the equilibrium condition of the bank's choice of purchase or non-purchase strategy is

$$P^* = \frac{C \cdot m - (1 - e)(d_2/2)\theta_2^2}{Q} \quad (3)$$

On the basis of equation (3), $(\partial P^*/\partial e) = (((d_2/2)\theta_2^2)/Q) > 0$ and $(\partial P^*/\partial \theta_2) = -(((1 - e)d_2\theta_2)/Q) < 0$ can be obtained. This equation indicates that the CDS seller's loss rate is positively correlated with the probability of credit default event, and the effort of the bank is negatively correlated with the probability of credit default event. This notion is due to the fact that the higher the CDS seller's loss rate is, the more credit risk the bank can spread to the CDS seller through CDS contracts. At this point, the bank's incentive to inspect the underlying assets before the loan is weakened, whereas the incentive to supervise the underlying assets after the loan is weakened. This situation leads to the adverse selection and moral hazard problems of SMEs; thus, the probability of credit default events increases (Figures 3–5).

3. Incentive Mechanism Model of CDS's Influence on SMEs' Credit Behavior

The relaxation of regulation before and after lending will lead to adverse selection and moral hazard problems of SMEs after banks purchase CDS products. On this basis, we assume that after the bank purchases CDS products, the loan audit intensity is weakened; that is, the bank is in a state of weak supervision, and the degree of weak supervision is set as V_1 . At the same time, banks can expand their liquidity by borrowing CDS to shift credit risk off their balance sheets. Suppose that when the bank has abundant liquidity, it can meet the loan demand m_1 of SMEs. Then, when the bank does not buy CDS products, the loan default risk is borne by the bank, and the bank is in a state of strong supervision. Suppose that the degree of strong supervision of the bank is V_2 and under the supervision intensity of loan examination and approval, the bank can only meet the loan demand of SMEs by m_2 .

FIGURE 3: Correlation between the probability of credit default event and CDS loss rate and bank effort θ_2 .

3.1. Further Assumptions

Hypothesis 4. When SMEs have a project that needs financing, the investment amount is m_i ($i = 1, 2$), its own capital is sufficiently small, and all the investment amounts are from bank loans.

Hypothesis 5. The principal of the loan applied by SMEs to the bank is m_i , the loan interest rate is r , and the repayment of SMEs is $(1 + r)m_i$ at maturity.

Hypothesis 6. A Cobb–Douglas production function is constructed to describe the nonlinear relationship between the credit capital (m_i) obtained by the enterprise from the bank and the labor input (θ_1), and $F = Am_i^\alpha \theta_1^\beta + \varepsilon$. $A \sim N(A_0, \delta_0^2)$, $A_0 > 0$, and $\delta_0 > 0$ are the prior expectation and standard deviation of the profitability of enterprise investment projects, and δ_0^2 directly reflects the volatility and risk of the profitability of enterprise investment projects. θ_1 is the size of the entrepreneur's labor input, including its operation efforts and work ability; $0 < \alpha \leq 1$ and $0 < \beta \leq 1$ are the output elasticity of loan capital and entrepreneur labor input. Moreover, ε is an exogenous random variable and follows a normal distribution $\varepsilon \sim N(0, \sigma^2)$. The effort cost of SMEs is $(d_1/2)\theta_1^2$, and d_1 is the enterprise effort cost coefficient.

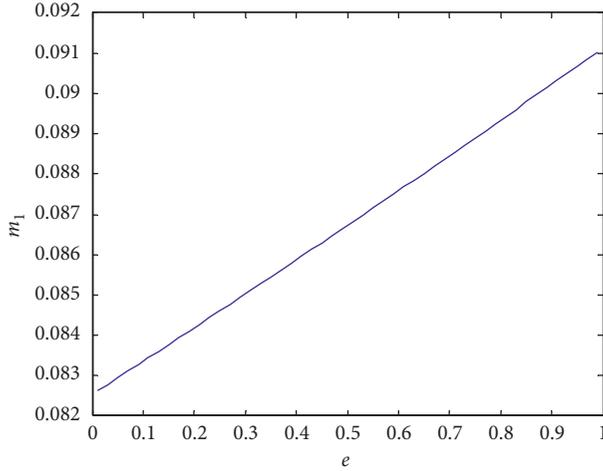


FIGURE 4: Relationship between loan amount applied by SMEs and CDS loss rate.

Hypothesis 7. The effort level of banks is affected by the effort level of enterprises and the credit cost. Let $\theta_2 = \sqrt{am - b\theta_1}$; and $am - b\theta_1 > 0$, $0 < a < 1$, and $0 < b < 1$. Thus, $(\partial\theta_2/\partial\theta_1) < 0$ and $(\partial\theta_2/\partial m) > 0$.

Hypothesis 8. The relaxation of supervision before and after lending by banks can increase the opportunity cost of SMEs. That is, when banks are in a weak state of supervision, SMEs can obtain the opportunity cost of $e \cdot (d_2/2)\theta_2^2$ units.

3.2. Model Construction and Analysis. On the basis of the above analysis, when the strategic choice space of banks for CDS products is $S = \{\text{Buy, Don't buy}\}$, under the influence of bank supervision and the amount of available credit, SMEs' behaviors after entering into credit contracts with banks are mainly manifested in the following two situations.

Case 1. When the bank purchases CDS products, under the regulatory strategy and credit principal strategy

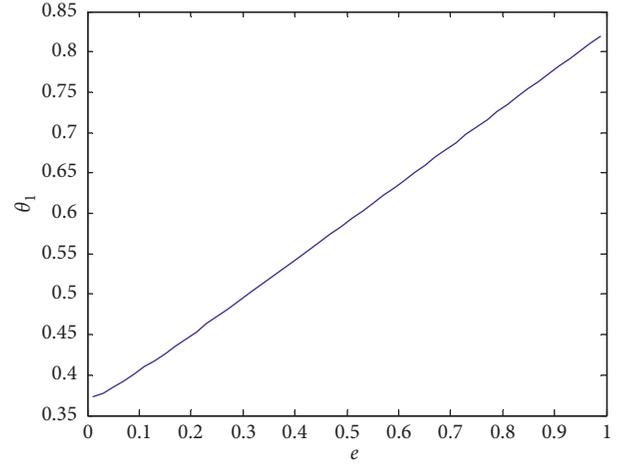


FIGURE 5: Relationship between SMEs' effort and CDS loss rate.

combination (V_1, m_1) selected by the bank, the investment cost and labor input strategy combination of SMEs is (m_1, θ_1) . Then, the income function of SMEs is

$$\max U(m_1, \theta_1) = Am_1^\alpha \theta_1^\beta + e \cdot \frac{d_2}{2} \left(\sqrt{am_1 - b\theta_1} \right)^2 - \frac{d_1}{2} \theta_1^2 - (1+r)m_1. \quad (4)$$

According to equation (4), when $(\partial U/\partial m_1) = 0$ and $(\partial U/\partial \theta_1) = 0$ are satisfied, $(\partial^2 U/\partial m_1^2) < 0$ and $(\partial^2 U/\partial \theta_1^2) < 0$ can be obtained, respectively. Therefore, if the investment income of SMEs reaches the maximum value, then their input loan cost and effort must be the maximum value.

In addition, $(\partial U/\partial m_1) = 0$ and $(\partial U/\partial \theta_1) = 0$ can be used to obtain that under the regulatory strategy and credit principal strategy combination (V_1, m_1) selected by the bank, the investment cost and labor input strategy combination (m_1, θ_1) of SMEs can be solved as follows:

$$m_1 = \frac{A^2 \cdot \alpha \cdot \beta}{d_1 [(1+r) - e \cdot (d_2/2) \cdot a]} - \frac{e \cdot (d_2/2) \cdot b}{d_1}, \quad (5)$$

$$\theta_1 = \left[\frac{(1+r) - e \cdot (d_2/2) \cdot a}{A \cdot \alpha} \right] \frac{1}{1-\alpha} \cdot \frac{A^2 \cdot \alpha \cdot \beta - e \cdot (d_2/2) \cdot b(1+r) + (e \cdot (d_2/2))^2 \cdot a \cdot b}{d_1 [(1+r) - e \cdot (d_2/2) \cdot a]}. \quad (6)$$

According to equation (5), we can obtain $(\partial m_1/\partial e) = (d_1 \cdot d_2 \cdot a/2d_2^2 [(1+r) - e \cdot (d_2/2) \cdot a]^2) - (d_2 \cdot b/2d_1)$. On the basis of the foregoing assumptions, when the conditions for $a > b[(1+r) - e \cdot (d_2/2) \cdot a]^2$ are met, $(\partial m_1/\partial e) > 0$. Thus, the higher the CDS seller's loss ratio is, the more credit risk will be shared by the bank, and the stronger the bank's willingness to meet the credit demand of SMEs to achieve profit maximization. Therefore, SMEs can obtain more loan amounts.

Equation (5) yields $(\partial \theta_1/\partial e) > 0$. Thus, the higher the CDS seller's loss rate is, the higher the efforts of SMEs will be. $(\partial \theta_2/\partial \theta_1) < 0$; that is, the higher the efforts of SMEs are, the weaker the bank supervision will be. Therefore, from $(\partial \theta_1/\partial e) > 0$ and $(\partial \theta_2/\partial \theta_1) < 0$, $(\partial \theta_2/\partial e) < 0$ can be obtained, which indicates that a negative correlation exists between the effort of bank credit supervision and the loss rate of credit default sellers. Moreover, after the bank purchases CDS products, the enthusiasm of the bank to supervise and

examine the credit assets before and after lending is likely to be reduced. This condition will not only lead to the problem of moral hazard in banks but also cause the problem of adverse selection in SMEs.

Case 2. When the bank does not purchase CDS products, under the regulatory strategy and credit principal strategy portfolio (V_2, m_2) selected by the bank, the investment cost and labor input strategy portfolio of SMEs is (m_2, θ_{1*}) . Then, the income function of SMEs is

$$\max U(m_2, \theta_{1*}) = Am_2^\alpha \theta_{1*}^\beta - \frac{d_1}{2} \theta_{1*}^2 - (1+r)m_2. \quad (7)$$

According to equation (7), when $(\partial U/\partial m_2) = 0$ and $(\partial U/\partial \theta_{1*}) = 0$, $(\partial^2 U/\partial m_2^2) < 0$ and $(\partial^2 U/\partial \theta_{1*}^2) < 0$ can be obtained, respectively. Similar to Case 1, the input loan cost and effort level should be the maximum value, such that the investment income of SMEs can reach the maximum value.

In addition, $(\partial U/\partial m_2) = 0$ and $(\partial U/\partial \theta_{1*}) = 0$ imply that under the regulatory strategy and credit principal strategy combination (V_2, m_2) selected by the bank, the investment cost and labor input strategy combination (m_2, θ_{1*}) of SMEs can be solved as follows:

$$\frac{A^2 \cdot \alpha \cdot \beta \cdot e \cdot (d_2/2) \cdot a - e \cdot (d_2/2) \cdot b(1+r)[(1+r) - e \cdot (d_2/2) \cdot a] - A^2 \cdot \alpha \cdot \beta [(1+r) - e \cdot (d_2/2) \cdot a]}{d_1(1+r)[(1+r) - e \cdot (d_2/2) \cdot a]} \geq 0.$$

According to equation (5), $m_1 \geq m_2$ is true when $e > ((2(1+r))/(d_2 \cdot a)) - ((2A^2 \cdot \alpha \cdot \beta)/(d_2 \cdot b \cdot (1+r)))$ is satisfied. Thus, Proposition 1 is proved.

After buying CDS products, banks disperse credit risks from the balance sheet to the off-balance sheet, which reduces banks' enthusiasm for the supervision of the quality of the underlying assets, resulting in a decline in the management efforts of SMEs and the creation of moral hazard. When banks do not purchase CDS, they will strictly examine the quality of the underlying assets to reduce nonperforming

and $\theta_{1*} > \theta_1$ because $(1+r)^{(\alpha/1-\alpha)} > [(1+r) - e \cdot (d_2/2) \cdot a]^{(\alpha/1-\alpha)}$ and

$$A^2 \cdot \alpha \cdot \beta > \left[A^2 \cdot \alpha \cdot \beta - e \cdot \frac{d_2}{2} \cdot b(1+r) + \left(e \cdot \frac{d_2}{2} \right)^2 \cdot a \cdot b \right]. \quad (13)$$

Thus, Proposition 2 is proved.

$$m_2 = \frac{A^2 \cdot \alpha \cdot \beta}{d_1(1+r)}, \quad (8)$$

$$\theta_{1*} = \left(\frac{1+r}{A \cdot \alpha} \right)^{1/1-\alpha} \cdot \frac{A^2 \cdot \alpha \cdot \beta}{d_1(1+r)}. \quad (9)$$

On the basis of the above analysis, when $e > ((2(1+r))/(d_2 \cdot a)) - ((2A^2 \cdot \alpha \cdot \beta)/(d_2 \cdot b \cdot (1+r)))$ is met, the bank can use CDS products to release capital liquidity and improve capital adequacy ratio, thereby increasing the amount of loans granted to SMEs and improving their financing difficulties. Thus, we propose the following.

Proposition 1. *SMEs can obtain a loan amount larger than that of the bank when it does not purchase CDS products when it purchases CDS products, namely, $m_1 \geq m_2$.*

Proof. According to equations (5) and (8), $m_1 \geq m_2$ is equivalent to

$$\frac{A^2 \cdot \alpha \cdot \beta}{d_1[(1+r) - e \cdot (d_2/2) \cdot a]} - \frac{e \cdot (d_2/2) \cdot b}{d_1} \geq \frac{A^2 \cdot \alpha \cdot \beta}{d_1(1+r)}. \quad (10)$$

That is,

$$\frac{A^2 \cdot \alpha \cdot \beta}{d_1[(1+r) - e \cdot (d_2/2) \cdot a]} - \frac{e \cdot (d_2/2) \cdot b}{d_1} - \frac{A^2 \cdot \alpha \cdot \beta}{d_1(1+r)} \geq 0, \quad (11)$$

assets. SMEs must increase their operation efforts to obtain bank loans in a long-term and smooth manner. Thus, we propose the following.

Proposition 2. *When the bank does not buy CDS products, the efforts of SMEs are greater than those of SMEs when the bank buy CDS products, namely, $\theta_{1*} > \theta_1$.*

Proof. For the convenience of calculation, let $\alpha + \beta = 1$. According to equations (6) and (9), $\theta_{1*} > \theta_1$ is equivalent to $(\theta_{1*}/\theta_1) > 1$, namely,

$$\frac{(1+r)^{(\alpha/1-\alpha)} \cdot A^2 \cdot \alpha \cdot \beta}{[(1+r) - e \cdot (d_2/2) \cdot a]^{(\alpha/1-\alpha)} [A^2 \cdot \alpha \cdot \beta - e \cdot (d_2/2) \cdot b(1+r) + (e \cdot (d_2/2))^2 \cdot a \cdot b]} > 1, \quad (12)$$

4. Conclusions

In the past, the traditional risk management methods of commercial banks mainly include pre- and postloan phases, including preloan mortgage guarantee, credit review, corporate credit rating, and postloan risk assessment, nonperforming loan inventory, and disposal of guarantee items. This method is a way of hedging only a small part of the risk of loan defaults, and the banks are still responsible for most of the credit losses. However,

CDS has changed the way of bank credit risk management by a negative, passive way of risk aversion to a positive and active portfolio risk management, which not only helps improve the income level and stability of the credit portfolio but also disperses the credit risk accumulated within the banking system. In the current study of the bank-enterprise game model, the influence of the change of the bank's credit risk management mode on the credit financing of SMEs is not considered. Aiming at this problem, on the basis of the perspective of CDS, we construct a game model of credit behavior incentive mechanism of banks and SMEs when considering CDS. We also discuss the influence mechanism of factors such as the coupon rate of CDS contract; CDS loss rate; credit effort of banks and enterprises; and the influence mechanism of factors, such as the change of the amount of loans obtained by enterprises on the credit financing of SMEs. Research shows the following. (1) With the help of CDS contracts, banks transfer the credit risks on the balance sheet to third-party financial institutions. As a result, the supervision of banks before and after lending is insufficient, and the probability of credit default events increases. (2) The functions of CDS in the slow-release and decomposition of credit risks can encourage banks to take more credit risks and fully meet the loan demands of SMEs. Therefore, under the CDS contract, SMEs can obtain more credit funds. (3) After banks purchase CDS, they are in a state of weak supervision to reduce costs and maximize profits. At this time, the management efforts of SMEs are weaker than those of banks under strong supervision, which can produce the moral hazard problem of SMEs.

On the basis of this study and combined with actual situations, the following countermeasures and suggestions are proposed for the credit problems of banks and enterprises. (1) A credit risk compensation fund for SMEs should be established, and the policy-based guarantee system should be improved. The establishment of the government risk compensation fund can play a role of credit enhancement for SMEs and help reduce the financing pressure of SMEs. At the same time, it can improve the tolerance of banks to credit risk. To a certain extent, it can reduce the threshold of bank lending. (2) Traditional risk management methods of banks should be transformed and enriched. The use of CDS will be table-reserved by banks' off-balance-sheet credit risk transfer. The credit risk of the subcontract to other investors, financial institutions, or CDS products effectively reduces the bank to dissolve the credit risk and systemically improve the efficiency of the disposal of nonperforming loans and bank risk management ability. (3) Risk management shortcomings of the problems of credit derivatives, especially the moral hazard and adverse selection problems, should be actively prevented. CDS products will not only improve banks' risk bearing capacity but also reduce their examination of borrowers' qualifications, as well as give opportunities to SMEs with bad reputation. If they do not actively prevent this problem, a new round of credit risks may be generated on both sides of the counterparties.

This study has only made a preliminary attempt on the credit financing contract mechanism of SMEs based on CDS contracts. Further research is needed on the refinement of the game model, concrete application, empirical test, investigation of relevant institutional and environmental

factors, and solutions to the problem of moral hazard within banks.

Data Availability

The method in this article is computer mathematical simulation. Numerical simulation analysis is the most effective way to test real-time dynamic data without a large number of empirical validations. The authors simulate to study the influence mechanism of SMEs credit financing on the CDS contract coupon rate, CDS payout ratio, and bank-enterprise credit effort, loan recovery rate when considering CDS by using MATLAB 2016b software. This paper does not have the data that can be obtained because they directly use the plot function of MATLAB 2016b software to make the images.

Disclosure

Shenghong Wu, Mu Pei, Jiaxian Shen, Wenyi Wang contributed equally to this work. They are co-first authors.

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding the publication of this paper.

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