

# Loan Model for Military-Civilian Integration of Small and Medium-Sized Enterprises

Zhengxuan Zhu<sup>1</sup>, Yongchao Tian<sup>2,\*</sup>

<sup>1</sup> *School of Economics and Management, Nanjing University of Science and Technology, Nanjing, Jiangsu 210018, China*

<sup>2</sup> *School of Economics and Management, Nanjing University of Science and Technology, Nanjing, Jiangsu 210018, China*

\*Corresponding author. Email: 1714479343@qq.com

## ABSTRACT

SMEs (Small and medium-sized enterprises) are the main force of innovation and deep participants in the civil-military integration strategy, but the traditional bank loan model cannot meet the capital needs of military-civil integration enterprises, nor can it meet the loan risk control concerns of banks. Therefore, this paper analyzes the characteristics of civil-military integration SMEs and the reasons for the difficulties of loans, expounds several new civil-military integration loan models, compares the old and new loan models through game analysis, and finally puts forward relevant suggestions.

**Keywords:** *SMEs, military-civilian integration, bank loan, game analysis*

## 1. INTRODUCTION

The national strategy of military-civilian integration is the CPC's (the Communist Party of China) new exploration of economic and national defense construction based on the requirements of the times and the basic national conditions. At present, China's military-civilian integration is still in the stage of transition from the initial stage to the deep integration, and it still faces challenges in various aspects such as technology, talent, and capital. As the most active group in the wave of military-civilian integration, SMEs' financing has become one of the obstacles to the deep integration of military and civilian. Some scholars [1-3] suggested to absorb social capital through the multi-level capital market and change the current financing status. However, the current financial system in China is based on banks, and the capital market is not yet developed. Large-scale financing through the capital market is not yet realistic. How commercial banks can meet the capital needs of military-civilian integration SMEs through loan business is a problem that needs to be explored and solved urgently.

## 2. MILITARY-CIVILIAN INTEGRATION SMES

### 2.1. Concept and Features

Military-civilian integration SMEs refer to small and medium-sized enterprises that are selected by the government according to certain criteria and participate in

both the civilian market and the military market. The essence of military-civilian integration is the conversion and sharing of military-civilian resources. The two resource flows represented by "military to civilian" and "civilian participation in the military" constitute the main connotation of current military-civilian integration. "Military to civilian" is the transformation of military technology into civilian use, and "civilian participation in the military" is the deep participation of social forces in national defense construction [4, 5].

Starting from the essence and connotation of military-civilian integration, combined with current military-civilian integration practices, military-civilian integration SMEs have the following characteristics: 1) high-tech, small and medium-sized military-civilian integration enterprises are mostly science and technology enterprises, with characteristics of high growth, high investment, high profitability and high risk, more intangible assets and less tangible assets, so they have urgent and frequent demand for working capital, just like ordinary science and technology enterprises; 2) military-civilian dual-use market, military-civilian integration is to promote the development of military-civilian dual-use technology, and military-civilian integrated enterprises have changed in recent years from a single market to a military-civilian market, but the civilian market and the military-industrial market are still relatively divided market [6]; 3) confidentiality, where military research and development and production involved, the requirements of confidentiality permeated all aspects of enterprise management and operation; 4) agglomeration development, military-civilian integration cluster development is the main practice model of military-civilian integration in various regions.

## 2.2. Reasons for Loan Difficulties

### 2.2.1. Information asymmetry

Enterprises have general characteristics that make loan activity difficult. These characteristics are imperfect organizational structure, financial chaos and lack of long-term development planning. Banks present loan challenges due to their lack of talents and experience in the field of military-civilian integration, and difficulty accessing corporate information. Thus, they cannot make an accurate judgment on the operation and development of such enterprises. Military-civilian integration involves many industries and subjects, and there are some institutional problems in it too. For example, there is a lack of effective system connection and integration between military and local governments.

### 2.2.2. Mismatch between risk and return

China's banks are low-risk and low-yield investors. For the development of military-civilian integration SMEs, banks often need to provide policy-driven preferential low interest rates. Banks face two problems: 1) the cost of information is too high, and the income from interest spreads is too low; 2) the loan risk is too great. Based on the above reasons, the problems of difficult and expensive financing for military-civilian integration SMEs have become prominent. Banks are afraid and unwilling to make loans. The traditional loan model cannot meet the needs of military-civilian integration. Under the traditional loan model, the characteristics of commercial banks' loans to SMEs are: 1) high emphasis on collateral; 2) strict approval and long cycle; 3) high financing costs. None of these characteristics apply easily to the military-civilian development capital needs.

## 3. EXPLORATION OF LOAN MODELS FOR MILITARY-CIVILIAN SMES

In order to respond to the national strategy of military-civilian integration, major banks have set up franchise institutions to better meet the needs of military-civilian integration: 1) green approval channels, which have greater authority; 2) greater tolerance of non-performing loans; 3) enhanced connect with other military-civilian integration service providers in order to build a credit information system for SMEs. The following are some new explorations of the loan model by the banking industry.

### 3.1. Online Supply Chain Model

The supply chain model innovatively uses the current assets generated by commercial credit among enterprises as the first repayment guarantee [7]. Large military enterprises are at the core of the military industry supply chain, while military-civilian integration SMEs accumulate upstream. Military-civilian integrated SMEs can apply for liquidity loans from banks through account receivable pledges, bill pledges or discounts, and order financing. The "Accounts Receivable Financing Changhong Model" is an online supply chain financing model launched by the People's Bank of China Credit Information Center and Chengdu Branch in collaboration with Changhong Group, as shown in Figure 1. As one of the largest military-civilian integration enterprises in Sichuan, Changhong Group has gathered a group of SMEs participating in military-civilian integration in its upstream. On July 18, 2017, the Zhongzheng platform and the Bank of China head office completed the system connection, forming an online accounts receivable financing model directly connected to the "Changhong-Zhongzheng Platform-Bank of China" tripartite system. Compared with the traditional loan model, the "Changhong-Zhongzheng platform-Bank of China" online receivables financing model has the following advantages: 1) based on real trade, the core company provides payment guarantee; 2) the system is 24-7 due to its online connectivity which facilitates access and information transfer; 3) include Central Bank's assistance and multi-layer fund protection.

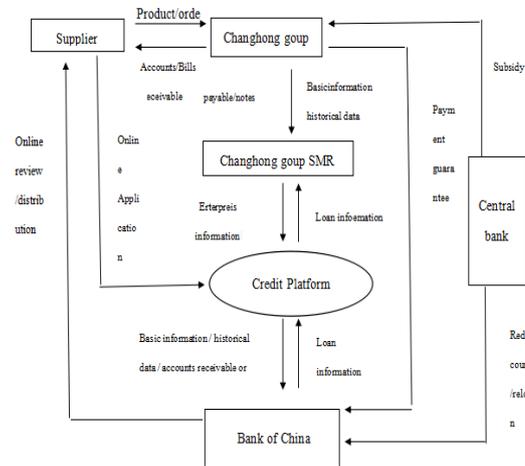


Figure 1 "Changhong-Zhongzheng platform-bank of China" online supply chain model

### 3.2. Intellectual Property Pledge Model

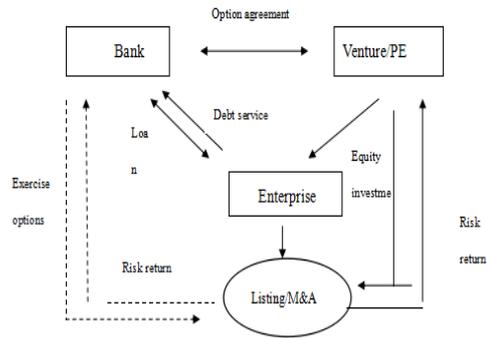
Intellectual property pledge means that an enterprise or individual uses the legally owned patent rights, trademark rights, and copyright rights as the pledge after appraisal and applies to the bank for financing. With policy support,

various regions have carried out pilot work on intellectual property pledges. Currently, the main mode of practice is the “government-bank-insurance /guarantee institution” multi-level risk-sharing intellectual property pledge loan. Banks alleviate information asymmetry by communicating with parks and insurance or guarantee institutions. Intellectual property rights assessment and transaction services enabled the realization of intellectual property value. At the same time, the government, banks and insurance parties share the risk of intellectual property pledge loans at certain designated percentage amounts. The Science and Technology Innovation Zone of Mianyang City has launched a “Science Innovation Loan” based on the pledge of intellectual property knowledge and the district management committee, banks and insurance, as shown in Figure 2. The District Management Committee invested 5 million yuan to set up a “Science and Innovation Loan” risk fund pool, and China Construction Bank carried out credit business at 8 times the total risk fund pool, and granted single-family loan companies a credit line of no more than 2 million yuan. The business provides insurance protection.

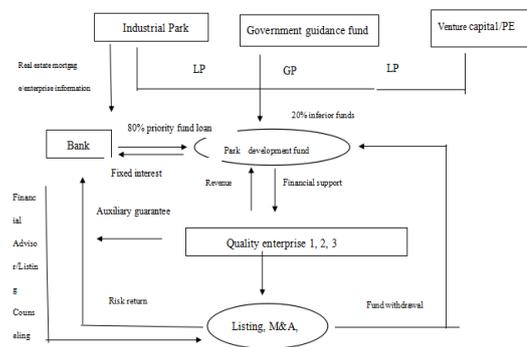
**3.3. Investment and Loan Linkage Model**

Investment and loan linkage is a kind of "equity + debt" financing method, in which credit assets are used by banks and linkage institutions to make equity investments. The investment and loan linkage financing model meets the needs of enterprises for short-term and long-term funds. The following are two typical forms of investment and loan linkage: 1) bank + PE/VC or subsidiary model: commercial banks cooperate with private equity funds or venture capital institutions, and can obtain equity premium income of listed companies through "option loans"; 2) industrial fund model: commercial banks and the government or society investment institutions jointly set up a military-civilian integration industrial fund, and invest in target enterprises through the industrial fund to realize investment and loan linkage business[8]. The process of two typical forms is shown in Figure 3 and Figure 4.

**Figure 2 Intellectual property pledge mode**



**Figure 3 Bank + PE/VC or subsidiary model**



**Figure 4 Investment and loan alliance model of special industrial parks**

**4. LOAN GAME ANALYSIS OF MILITARY-CIVILIAN INTEGRATED ENTERPRISES**

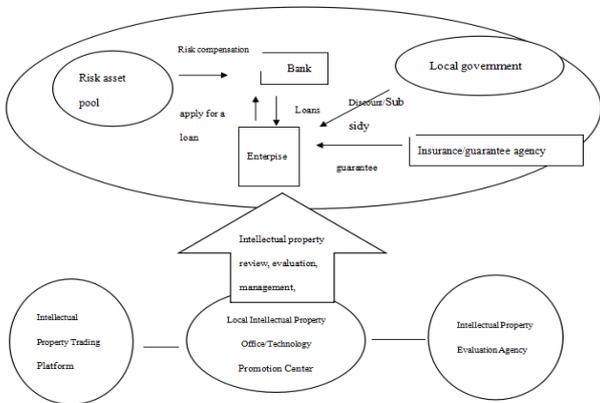
This section carries out game analysis on the loan model of military and civilian integration SMEs.

**4.1. Mortgage Model**

In the traditional bank loan model, military-civilian integration SMEs generally need to provide certain collateral, so bank mortgage loans are used as the analysis object. To simplify the model, the following assumptions are proposed:

Hypothesis 1: the bank has two strategies: "loan" and "non-loan", with probability  $x$  and  $1-x$ , respectively, and the enterprise has two strategies, "repayment" and "default", with probability  $y$  and  $1-y$ , respectively.

Hypothesis 2: the enterprise's capital demand is set to 1, the project investment return rate is  $R$ , the loan interest rate is  $r$ , the collateral  $m$  needs to be provided, the evaluation fee is  $n$  times the collateral, and other expenses are  $a$ .



Hypothesis 3: the bank can invest the funds in a risk-free investment with a return rate  $r_f$  and a loan interest rate  $r$  greater than the risk-free return  $r_f$ .

The payment matrix is shown in Table 1. The expected returns of the bank choosing "loan" and "non-loan" strategies and mixed strategies are:  $E_1 = yr + (1-y)(m-1)$ ,  $E_2 = r_f$  and  $E = xE_1 + (1-x)E_2$ . According to the Malthusian dynamic equation [9], the growth rate of a strategy is equal to its relative fitness, as long as the individual income of the strategy is higher than the average income of the group, the strategy will grow. The bank's replicator dynamic equation is:

$$\begin{aligned} \frac{dx}{dt} &= x(E_1 - E) \\ &= x(1-x)[yr + (1-y)(m-1) - r_f] \\ &= x(1-x)[y(1+nm) + m - 1 - r_f] \end{aligned} \tag{1}$$

$dx/dt$  reflects the relationship between the bank's "loan" strategy and time. When the value is greater than 0, it indicates that the proportion of banks choosing "loan" strategy increases with time.

In the same way, the dynamic equation of the replicator of the enterprise is:

$$\begin{aligned} \frac{dy}{dt} &= y(1-y)x[R - r - nm - a - (1+r-m-nm-a)] \\ &= y(1-y)x(m-1-r) \end{aligned} \tag{2}$$

When  $1+r > 1+r_f > m$ , in the case of enterprise repayment, the bank loan income is greater than the non-loan income. In the case of the enterprise default, the bank chooses not to loan income above the loan income. When  $y > (1+r_f-m)/(1+r-m)$ ,  $dx/dt > 0$ ,  $x=1$  is the evolutionary stability point, the bank chooses the "loan" strategy after long-term evolution.

When  $y < (1+r_f-m)/(1+r-m)$ ,  $dx/dt < 0$ ,  $x=0$  is the evolutionary stability point, and the bank chooses the "non-loan" strategy after long-term evolution.

When  $1+r > m > 1+r_f$ , regardless of whether the enterprise repays, the bank loan income is greater than the non-loan income,  $(1+r_f-m)/(1+r-m) < 0$ , so  $y > (1+r_f-m)/(1+r-m)$ ,  $x=1$  is the evolutionary stability point. After long-term evolution, the bank will choose the "loan" strategy, which does not depend on the choice of the enterprise. When  $m > 1+r > 1+r_f$ , regardless of the enterprise repayment, bank loan income is greater than non-loan income,  $y < 1 < (1+r_f-m)/(1+r-m)$  or  $dx/dt = x(1-x)(m-1-r_f)$ ,  $dx/dt > 0$ ,  $x=1$  is the point of evolutionary stability. After long-term evolution, the bank will choose the "loan" strategy, which does not depend on the choice of the enterprise. That is, when  $1+r_f < m$ , "loan" is a long-term evolutionary stable selection strategy for banks.

**Table 1** Game payment matrix

		Enterprise			
		Repayment y		Default 1-y	
bank	loanx	r	R-r-(mn+a)	m-1	1+R-m-nm-a

		enterprise			
		repaymenty		default1-y	
bank	loanx	r	R-r-a	(1-p)(m-1)+pr	1+R-m-a-b

When  $1+r > m$ , the principal and interest of the enterprise loan is greater than the value of the mortgage asset. After a long-term evolution,  $y=0$  is the stable strategy, and the enterprise will choose "default". Otherwise,  $1+r < m$ , the principal and interest of the enterprise loan is less than the mortgage asset value, after long-term evolution, the enterprise will choose the "loan repayment" strategy, neither result depends on the bank's strategic choice.

**4.2. New loan model**

Based on the foregoing, the following assumptions are made.

Hypothesis 4: the enterprise breaching the contract will be punished by an external breach of contract with the amount of  $b$ .

Hypothesis 5: in the event of a corporate default, the third party etc. bears a certain proportion of the insufficient portion of the collateral, the ratio is  $p$ ,  $m < 1 +$

The payment matrix is shown in Table 2. The expected returns of banks choosing "loan", "non-loan" and mixed strategy strategies are:  $F_1 = yr + (1-y)[(1-p)(m-1) + pr]$ ,  $F_2 = r_f$  and  $F = xF_1 + (1-x)F_2$ . According to the Malthusian dynamic equation, the bank's replicator dynamic equation is:

$$\begin{aligned} \frac{dx}{dt} &= x(F_1 - F) \\ &= X(1-X)\{y(1-p)(1+r+m) + (1-p)(m-1) - r_f + pr\} \end{aligned} \tag{3}$$

In the same way, the dynamic equation of the replicator of the enterprise is:

$$\frac{dy}{dt} = xy(1-y)(m+b-1-r) \tag{4}$$

In view of the shortage of collateral in small and medium-sized enterprises, set  $1+r > m$ .

When  $p=0$ , the third party will not be compensated at all,  $dx/dt = x(1-x)[y(1+r-m) + m - 1 - r_f]$ , the results are analyzed in mortgage. When  $p=1$ , the third party is fully compensated,  $dx/dt = x(1-x)(r-r_f) > 0$ , after long-term evolution, the bank chooses the "loan" strategy, which does not depend on the enterprise strategy.

**Table 2** Game payment matrix of new loan

		enterprise			
		repaymenty		default1-y	
bank	loanx	r	R-r-a	(1-p)(m-1)+pr	1+R-m-a-b

		enterprise			
		repaymenty		default1-y	
bank	loanx	r	R-r-a	(1-p)(m-1)+pr	1+R-m-a-b

When  $0 < p < 1, (1-p)(1+r-m) > 0$ , let  $dx/dt > 0, y > [(1-p)(1+r-m) - p(r-r_i)] / (1-p)(1+r-m) = (1+r-r_i) / (1+r-m) - p(r-r_i) / (1-p)(1+r-m)$ . Because  $r > r_i, p(r-r_i) / (1-p)(1+r-m) > 0$ , and as  $p$  increases, the value increases. Combined with the relevant analysis about mortgage, it can be seen that when there is tripartite compensation, under a long-term evolution, the critical value  $y$  of the bank's "loan" strategy is lower, which means that the bank can tolerate a higher non-performing loan rate. With the compensation ratio  $p$  increase, the threshold value is further reduced.

When  $m+b=1+r, dy/dt=0$ , all  $y$  are stable.

When  $m+b > 1+r, dy/dt > 0, y=1$  is the long-term stability point, the enterprise's long-term evolution strategy is selected as "repayment". Thus, when the value of the collateral provided by the enterprise and the external penalty for dishonesty are greater than the principal and interest, more enterprises choose to repay than when  $m+b < 1+r, dy/dt < 0, y=0$  is the long-term stability point, and the enterprise's long-term evolution strategy is selected as "default". Therefore, the value of collateral and the external penalty for dishonesty are less than the principal and interest of the loan. More companies choose to default, and the two results do not depend on the choice of the bank.

### 4.3. Games Analysis Review

Thus, from the analysis of evolutionary games, the value of the mortgage is an important factor that affects the decision-making of both banks and enterprises. Under the simplified game, when the value of the collateral is greater than the gains from risk-free investment, loans are a better choice for banks. At the same time, when the value of the collateral exceeds the principal and interest of the enterprise loan, the enterprise is also more willing to perform its repayment obligations. However, military-civilian integration SMEs accumulating in the high-tech field, generally have problems of insufficient collateral or unstable collateral value. When the value of the collateral cannot cover the risk exposure of the bank, the bank's risk is increased and reduced the likelihood of their participation in military-civilian integration. Under long-term evolution, the proportion of companies that "default" has increased, and the high non-performing loan ratio has also made banks refuse loans. On the other hand, although the interest rate of banks' loans to SMEs is higher than that of large enterprises, in fact, large enterprises have a large amount of loans, long maturity, strong repayment willingness and ability, and the loan efficiency for large enterprises is higher than that of SME loans.

From the perspective of evolutionary games, the actual benefit  $r$  of SMEs' loans is less than  $r_f$ . At this time,  $y < (1+r-r_i) / (1+r-m)$ , and the bank's "non-loan" is a stable strategy for long-term evolution. In order to promote the in-depth development of military-civilian integration, policy-driven banks must give military-civilian integration

SMEs a certain preferential interest rate, and they need to relax the entry threshold for such corporate loans. Through evolutionary games, traditional mortgage models cannot satisfy the capital needs of military-civilian integration SMEs and the risk control needs of banks. Under the new loan model, enterprises are subject to obvious external constraints. When the value of collateral and external punishment for breach of trust are greater than the principal and interest of the loan, the enterprise has a greater willingness to repay. From the perspective of the bank, due to the introduction of more pledges and tripartite risk compensation, under a lower enterprise repayment ratio, the bank will still choose a loan strategy. The high risk of the military-civilian integration project determines the SMEs have higher non-performing loan rate than ordinary enterprises. But several new loan models allow banks to tolerate higher non-performing loan rates, and as the compensation ratio increases, third-party compensation also covers certain risk exposures of the bank and meets the bank's risk control needs.

## 5. SUMMARY AND RECOMMENDATIONS

In order to support the in-depth development of military-civilian integration and solve the problems of financing difficulties for military-civilian integration SMEs, commercial banks have conducted a series of beneficial explorations under the policy support. Some banks have established a military-civilian integrated enterprise franchise or department to increase the speed of approval and relax regulatory requirements. These franchises have broaden the pledge financing channels of the enterprise, and set up a multi-level risk sharing mechanism with the government and external agencies to reduce the risk of bank loans. The linkage of investment and loan helps military-civilian integration enterprises go public, opens up opportunities for mergers and acquisitions, and provides banks the chance to gain the long-term development benefits of enterprises. Through game analysis, the new loan model can better meet the financing needs of military-civilian integration SMEs while allowing bank risk control. To implement the loan service for military-civilian integration SMEs, all parties should also: 1) strengthen the dedicated attitude and professional ability of the bank's franchised institutions, abandon the old habits of property rights discrimination and scale discrimination, establish a military-civilian integration and financial composite talent team; 2) strengthen the construction of the SME credit system, establish and improve the SME credit information sharing mechanisms to create a good financial ecological environment for trustworthy incentives and disciplinary punishment; 3) improve military and civilian technology support services, promote the reform of the management system for the use of scientific and technological achievements, and improve the income distribution and incentive mechanism for the transfer of scientific and technological achievements.

## ACKNOWLEDGMENT

This article is the subject of 2019 Jiangsu Province Graduate Research and Practice Innovation Program (sponsors)(SJCX19\_0018).

## REFERENCES

- [1]Chen Liping. Building a military-civilian integrated financial service system, *China Finance*, 2018(19) 95-96.
- [2]Zhan Yong, Zhao Chunkai. Capital market development, military-civilian integration and industrial structure optimization and upgrading, *Nankai Economic Research*, (5) (2016)36-54.
- [3]Zhao Yiran, Chen Li. Several suggestions for accelerating the construction of a national military-civilian financial support system, *National Defense*, (3) (2017) 36-39
- [4]Yang Yang, Han Jiawei. "Military to civilian" in the integration of science, technology and civilian in my country: situation and problems, *Global Science and Technology Economic Observation*, 33(03) (2018) 42-46.
- [5]Guo Yebo. The basic status, existing problems and countermeasure of our national military participation, *China Economic and Trade Guide*, 2016(24) 77-79.
- [6] Bian Huimin, Yu Chuanying, Yang Xiaojie. The Dilemma and Countermeasures of Sichuan "People Participating in the Army" under the Background of Deeply Integrated Military and Civil Development, *Western Economic Management Forum*, 29(05) (2018)1-6.
- [7]Cai Hengjin, Guo Zhen. Discussion on the new framework of supply chain financial services: blockchain + big data, *Theoretical Discussion*, 2019(02) 94-101.
- [8]Li Ting. Sichuan exploration of the military-civilian integration industry: logic and plan of industrial fund, *Shang*, 2016(33)289-290.
- [9]WEIBULL JW. *Evolutionary game theory*, Cambridge, MA: The MIT Press, (1996).