

Evolution Mechanism of Synergy in Industrial-Financial Groups

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Abstract — An Industry-Finance group is a new type of enterprise that resulted from the mutual alliance of capital and management between industrial and financial organizations, as well as a consequence of self-organization co-evolution on industrial-financial integration from claims model to equity model. Based on synergetics and self-organization theory, this Paper constructs a theoretical model of the ability of synergic development on Industrial-Financial Group System, whose evolutionary process and mechanism is studied by self-organization motion equation and potential functions. Studies show that the order parameter of Industry-Finance group system is the ability of synergic development in these systems, which is composed of subsystems including industrial capital, financial capital, human capital and intangible assets whose evolutionary process is a process of potential functions and non-equilibrium phase transition.

Keywords - *Industrial-Financial Group System; ability of synergic development; evolution mechanism.*

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I. INTRODUCTION

Since 1990s, along with the relaxation of financial regulation and the opening of financial market, especially with the rapid promotion of information technology and its widespread use in financial industry, the trend of mutual alliance between industrial capital and financial capital become active gradually. And the alliance form also shows diversified characteristics. Industrial-financial group, taking equity model of industry and finance alliance as characteristics, has become the unstoppable financial and industrial innovation tide. It is also in the ascendant domestically.

From the global perspective, there are three typical modes for industrial-financial group development ^[1]: The first one is the American loose type industrial-financial group development mode, which has close relationship with the developed capital market, relatively loose bank system and enterprise system inclined to financing equity through capital market. The second one is the Germanic intensive type industrial-financial group development mode. This mode derives from the Germanic typical financial system dominated by the universal bank. The third one is the Japanese relationship type industrial-financial group development mode ^[2], which is determined by the main bank system tradition of mutual holdings between Japanese industrial organizations and financial institutions. From the domestic perspective, recently, enterprises with certain scales of industrial capital like Haier Group, D’long Group and etc. have entered into the financial field through various methods like setting up, share participation, share control or taking over financial institutions or setting up financial sector company. They have strategy of seeking to occupy

the financial highlands, build industrial-financial group which matches the characteristics of their own industrial development and has formed the unique mode of Chinese industrial-financial group development. Meanwhile, financial capitals represented by CITIC Group also permeate rapidly to industrial capital and formed the industrial-financial type enterprises group featuring the alliance of financial capital and industrial capital. According to the estimation of People’s Bank of China, China has about 528 non-financial enterprises that control or participate in above two kinds of financial institutions simultaneously. There are 57 non-financial enterprise type financial holding group (i.e. industrial-financial group) ^[3]. The formation of these industrial-financial groups is mainly presented in 3 aspects ^[4]. Firstly, it is evolved from large industrial enterprises or enterprise groups mainly in energy, transportation, electric power and steel fields. The state-owned enterprises are primary in electronic power, energy, transportation and other monopolized industries like China Huaneng, China National Aviation Holding Company, Orient Group, Hongta Group, Baosteel Group, Shandong Electric Power Group, Southern Airlines, Eastern Airlines, as well as CITIC Group, Everbright Group, etc.. For private enterprises, they are mainly public companies with well capital, like New Hope Group, D’long Group, etc. Secondly, enterprises are established by local governments adjusting the distribution of local state-owned economy, restructuring state-owned enterprises and operating capital. The typical representatives include Beijing Capital Group, Shanghai International Group, Shanghai Lianhe Investment Co., Ltd., China Merchants Group, Tianjin Teda Investment Holding Co., Ltd., Jiangsu Guoxin Investment Group Limited, Suzhou International Development Group Co., Ltd., Wuxi

Guolian Group, Shandong Luneng Investment Holding Group, etc. Thirdly, enterprises constitute from industrial enterprises share-holding or participation financial institutions. The typical representatives as Shanghai Aijian Group, Lianda Group, Shenzhen Zhongjin Joint Industrial Development Co., Ltd., Baotou Lvyuan Holding Co., Ltd., etc.

From the relationship between the internal industrial capital and financial capital in industrial-financial group, there are mainly two modes for the development of China industrial-financial group^[5]. Firstly, the industrial capital permeates into the financial capital through share participation or control. This formation began from the end of 1980s and the beginning of 1990s. In which, the main method is the alliance between industrial capital and bank capital. Recently, the new features of industrial-financial group development become the share control or participation of brokers as group, big enterprise group acquisition and holding Securities Company, Trust Company and Insurance Company. Haier Group and New Hope Group are the typical representatives of this type and it can also be called as Haier Mode. Secondly, the industrial enterprises set up their own commercial bank, financial company and other financial sector company. In 1992, with the approval of The People's Bank of China, Shougang Group established Huaxia Bank which possessed Investment and project set up right, foreign trade autonomy and capital financing right. Huaxia Bank is the other mode of industrial capital permeating into financial capital, which can also be called as Shougang Mode.

Industrial-Financial Group through alliance of industry and finance can achieve resource sharing and complementation between industrial capital and financial capital and reach a combined effect that the whole value is greater than the separation operation value of each member institution, i.e. synergistic effect. However, if the synergy between industrial capital and financial capital fails, it may cause negative synergistic effects such as alliance trading risks, interest confliction risks, shareholders control right risks, risk infection and overflowing^[6]. However, the current developing status of China industrial-financial group indicates: China industrial-financial group is driven by market financing difficulties instead of industrial strategic development. Therefore, during the process of industrial and financial capital alliance, the opportunist motives of industrial capital and financial capital become the starting point of the formation and development of China industrial-financial group. The development of China industrial-financial group only shows the formation of alliance instead of the truly functional alliance between industry and finance industry, which cannot full play the synergistic effects such as strategic synergy, management synergy, operation synergy and financial synergy, further more fail to realize the factor synergy of industrial capital, financial capital and human resource. The absence of synergistic mechanism causes the breed and diffusion of synergistic risks. It cannot produce synergistic effects or synergistic value, but will form internal friction and encumber the sound development

of the whole industrial-financial group. Because D'long Group did not master the tempo of the portfolio among long-, medium- and short-term investment, leading to its capital chain for short loan and long investment broken; Its industries, financial contents and their combinations cannot form synergy and complementation. The existence of financial institution cannot work the complementary effect, instead perform the retro-regulation function. That means the capital provided by the financial institution to D'long accelerate its dramatic expansion during economy expansion, and worsen its financial difficulty during economic contraction. Finally, it caused the collapse of Delong Group because of the sudden capital chain breaking during blind expansion. The above analysis indicates that the ability of synergic development on industrial-financial group has become the key and core problem for the benign development of China industrial-financial group. It has become the common concerned key point of the industry fields and theoretical cycle about how to make the industrial-financial group operation synergistically and raise synergistic effect through enhancing the ability of synergistic development.

This Paper believes^[8] that industrial-financial group is a new type of enterprise group establish upon the mutual penetration and alliance in capital and management between industrial organizations and financial organizations, as well as a consequence of self-organization coevolution on industrial-financial integration from claims model to equity model. Through self-organization and other-organization strategies, industrial-financial group merges multi-industries with finance industry and forms an industrial-financial system that fuses various subsystems. Under the impact of order parameter and control parameter, the industrial-financial system can achieve self-organization evolution campaign through the competition, coexistence and cooperation of the various internal subsystems and push the industrial-financial system go from disorder to orderable, from industrial-financial separation to alliance.

According to self-organization theory^[9], to achieve industrial-financial group system synergic effect and improve synergic value is mainly depend upon the order parameter of industrial-financial group system, i.e. the self-organization transition of synergic development ability. However, due to the research of synergic development ability is still in the beginning phase, there are rarely existing documents concerning synergic development ability. Teece、Pisano and Shuen (1997)^[10] had recognized the importance of synergic development ability and researched the status of enterprises' resource integration capability in enterprises innovation capability. Kaplan、Norton (2006)^[11] used Blanced Scorecad (BSC) theory to research how enterprises create enterprise synergic development ability through organize synergic ability. Zheng Shenghua, Rui Mingjie and others (2007)^[12] researched the basic framework of enterprise alliance capability and the mechanism to raise alliance performance by utilizing self-organization theory. Tang Jianxiong and Wang Guoshun (2008)^[13] researched the enterprise strategic transformation

capability by applying self-introduction theory. In general, the current researches either place emphasis on the single factor analysis on synergic development ability and ignore the system factor synergic ability, or restricted to general description and lack of normative analysis. Based on this, this Paper establishes the theoretical model of industrial-financial group system synergic development ability on the basis of synergy and self-organization theory, and researches the self-organization process and evolutionary mechanism of industrial-financial group system synergic development ability by applying system self-organization motion equation and potential functions through the description of non-equilibrium phase transition, symmetry breaking and bifurcation phenomenon.

II. THE THEORETICAL MODEL OF THE ABILITY OF SYNERGIC DEVELOPMENT ON INDUSTRIAL-FINANCIAL GROUP SYSTEM

Synergic development ability is an ability based on the synergic operation of resources integration, while the industrial-financial group system contains four classes of resources including industrial capital, financial capital, human resource capital and intangible capital. These form the thinking structure of industrial-financial group system synergic development ability. This can be expressed as follows. The ability of synergic development on Industrial-Financial Group System= F (industrial capital, financial capital, human resource capital and intangible capital) Because of the diversity, heterogeneity and local non-equilibrium of system components and their anfractuosity mutual influences and impacts, these components compete and collaborate with each other in the process to achieve the whole systematic purposes. This becomes the basic impetus of system evolution. According to the synergetic theory of self-organization, the self-organized process of factor system does not have an external force against the system in a particular way. Therefore, the formation and evolution of ordered structure cannot be described by the response procedure of state variable against the external force, but an internal process. Therefore, we regard the external environment force as constant and its changes are just random fluctuation. The formation and evolution process of the system internal synergic ability can be regarded approximately as the self-organization motion process in the internal of the industrial-financial system and it is the results of the mutual interaction, status changes and cross catalysis among all subsystems. Described by self-organization equation, we can build the dynamic theory model for the synergetic development ability of industrial-financial group system as follows:

$$\begin{aligned}\frac{dS}{dt} &= -KS + g(I, F, H, A) + F \\ \frac{dI}{dt} &= -K_1I + g_1(I, F, H, A) \\ \frac{dF}{dt} &= -K_2F + g_2(I, F, H, A) \\ \frac{dH}{dt} &= -K_3H + g_3(I, F, H, A) \\ \frac{dA}{dt} &= -K_4A + g_4(I, F, H, A)\end{aligned}\quad (1)$$

In the model, I, F, H, A and S represent the industrial capital, financial capital, human resource capital, intangible capital and synergic development ability of industrial-financial group system respectively; K_1, K_2, K_3, K_4 and K represent the relationship between change rate and original status of I, F, H, A and S respectively;

g_1, g_2, g_3, g_4 and g represent to impact degree of synergic effect caused by industrial-financial group system random fluctuation external force of industrial capital, financial capital, human resource capital, intangible capital against the change rate in the system of I, F, H, A and S ; F represents the impact of random fluctuation external force against the change of synergic development ability of industrial-financial group system and t represents the time.

In the model, the 5 formulas represent the synergic development ability of industrial-financial group system and the evolution law of all subsystems along with the time changes. Meanwhile, this model also describes the self-organization action mechanism of synergic development ability of industrial-financial group system. The self-organization action process not only promotes the formation and evolution of synergic development ability of industrial-financial group system, but also promotes the transition and changes among all the internal subsystems.

According to the server principle of synergetics [14], the ordered structure of system is determined by a few models or variables that increase slowly. All subsystems are under the control of these few models. We can describe the system evolution through these few slow variables. All subsystems of industrial-financial group system often exchange material, energy and information with external environment. It is influenced and acted by the external environment and appears the situation of unstable model support stable model and the slow relaxed variable support quick relaxed variable; Meanwhile, synergic development ability of industrial-financial group system is synergy generated from four resource systems with strong stabilities and dominates all subsystems and drive the motion evolution of all resource subsystems and achieve its own self-organization evolution. Therefore, there is no need for us to pay attention to all variables and factors. We only need to capture the determinative order parameter so that we can

master the order evolution process of the system through few variables.

III. SELF-ORGANIZATION MOTION EQUATION OF THE SYNERGIC DEVELOPMENT ABILITY OF INDUSTRIAL-FINANCIAL GROUP

Seemingly, although there are many differences in different systems of various subjects, they comply with same or similar partial differential equations [15] in the evolution process from disorder to orderable. We can research how the synergetics gets the evolution law of internal synergy from the perspective of dynamics through the solution to canonical equation and stability analysis. While all synergetics researches towards system structure, performance and evolution behaviors can be simmered down to researches towards potential function. Potential, in the society system, means the ability to adapt certain trend or ability from one status tend to another. It is an external outward manifestation of the coherence effects among all subsystems in the system. Below we will use potential function to study the self-organization evolution process of synergic development ability of industrial-financial group system [16] [17].

$$\frac{dS}{dt} = (-K + G)S - \beta S^3 + F \quad (2)$$

The most typical potential function is:

$V(q) = \frac{1}{2}Kq^2 + \frac{1}{4}K_1q^4$. The self-organization motion equation is: $\bar{q} = -Kq - K_1q^3$. Similarly, the S nonlinearity self-organization motion equation of the synergic development ability of industrial-financial group system can be presented as follows approximately:

$$\frac{dS}{dt} = (-K + G)S - \beta S^3 + F \quad (2)$$

In the equation, K represents the relationship between the change rate of the synergic development ability of industrial-financial group system and the original status, $-\beta S^3$ represents the nonlinearity formed in the synergic development ability of industrial-financial group system, F represents the random fluctuation force effects of external environment, G represents the control parameter that promotes the self-organization evolution of industrial-financial system.

Accordingly, the potential function of the synergic development ability of industrial-financial group system can present as follows:

$$V(S) = -\frac{1}{2}(-K + G)S^2 + \frac{1}{4}\beta S^4 \quad (3)$$

Formula (3) is homogeneous. $\bar{A} = 0$ must be its solution. We can assume that the original stable status of the synergic development ability of industrial-financial group system is described by $A = 0$. If the company has no operation activities in the operation process, it will always keep $\bar{A} = 0$ and cannot generate self-organization. But, it is

obviously unrealistic. Enterprise, as an open system, as long as it keeps functioning, it will exchange material, information and energy with external world continually. All resource subsystems within the company will also change continually and interact, so it will inevitably occurs random disturbance, like external environment changes, related transaction within the system, key personnel leave, etc. It will finally appear fluctuations by instantaneous value of synergic ability often deviated from the average, because of the separation motion of subsystems as well as the local coupling between each other, and environmental activity random fluctuation. These ups and downs are fluctuations. These fluctuations have continuous impact on the industrial-financial group system. When dramatic fluctuation occurs, there will be new order status, i.e. fluctuation conformed to the boundary conditions will get response and be magnified, and trigger the dominant power of system evolution. That means the formation of order parameter. Therefore, the order parameter of industrial-financial group system is the evolution process of the ability of system synergic development and also an improvement process of the ordered status of industrial-financial group system. It is also the process that the new structure of industrial-financial group system takes over the old structure.

For the potential function formula (3), its shape will change by changing the variables G and β . The curve shape of this function formula is determined by the coefficient of its quadratic term. And we can explain the changes of macro-state of the industrial-financial group system through the changes of the potential function minimal value. For this potential formula, we do analyze as follows:

(1) When $(-K + G) < 0$, the curve of potential function is as indicated in graph 1 (a). Under this condition, the motion evolution behavior of synergic ability of industrial-financial system is like the particle at the valley bottom of the potential function. Under the continuously strike of random fluctuation external force, it may go up along with the potential function slope and departure the valley bottom, but it will go back to the valley bottom under the impact of resilience. This indicates that the potential energy of the evolution of group system synergic development ability is relatively weak and the synergic effect within the group system is also weak.

(2) When $(-K + G) > 0$, the curve of potential function is as indicated in graph 1 (b). From the potential function curve, we can see that the original balance location $(S_0, 0)$ has become the unstable point. When there is no fluctuation, the particles show in the two potential energy valley with same probability. The synergic development ability can evolve from $(S_0, 0)$ to a new balance point $(-S_1, V), (+S_1, V)$. The ability of group system synergic development ability will evolve form one status to various possible statuses, thus forms the system none-equilibrium phase-transition. This indicates that the evolution potential energy of the group system synergic development ability is relatively strong, and the effect of system internal self-organization is relatively strong. In this way, not only the

system synergic development ability itself can evolve easily, but also can govern and strengthen the evolution of subsystems.

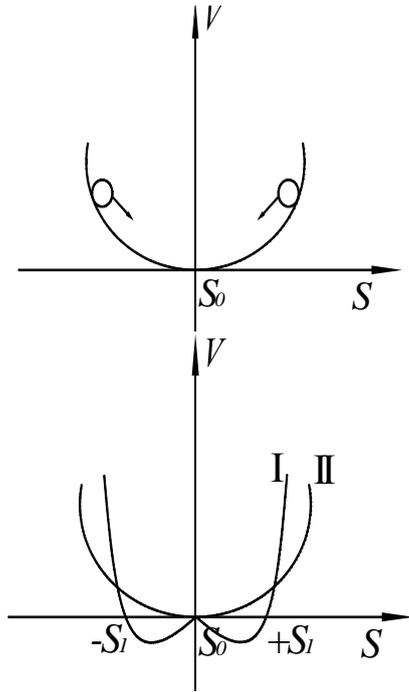


Fig.1. Potential function curve of the industrial-financial group system synergic development ability

IV. THE EVOLUTION PROCESS OF THE INDUSTRIAL-FINANCIAL GROUP SYSTEM SYNERGIC DEVELOPMENT ABILITY

Industrial-financial alliance is a kind of mutation in the evolution of industrial-financial system. Both the generative process of industrial-financial group system and the evolution process after the Industrial-financial alliance comply with the complex system evolution law, i.e. [18]: (1) systems are all open and in the unbalance status that is far from the balance status; (2) When a certain parameter increases to the certain threshold value, the original status becomes unstable and the critical state occurs to reach a new stable state. This process is spontaneous, which is called none-equilibrium phase-transition; (3) The new stable status is more orderable than the old one and the mutation from disorder to orderable, which is called the orderable transition under unbalance status; (4) After the critical point, it will form orderable structure and the symmetry will reduce, which is called symmetry breaking. (5) When the system is approaching the critical point, it will appear bifurcation phenomenon after departure from the original status because of fluctuation. Below we will use the order parameter of industrial-financial group system, i.e. the potential function motion curve and its none-equilibrium phase transition of system synergic ability to describe this evolution process.

A. Nonequilibrium Phase Transition

After long-term catalysis, emergence and cumulative, the industrial-financial group will appear the self-organization structure and stable status. At this time, the order parameter will make the industrial-financial system stable as S_0 status. Although the system internal structure and external environment have random disturbance now and then, but because of the system is around stable status, these minimal fluctuations won't have great impact on its stability. At this time, the potential function curve of the industrial-financial group system synergic development ability is indicated as graph 2 curve I, the motion of industrial-financial group system synergic development ability will follow its original track.

Along with the gradually change of external control parameters, the evolution law of synergic development ability will change accordingly. We assume that other parameters remain the same. When the quadratic term coefficient $(-K + G)$ of synergic development ability potential function changes from negative to positive, the potential function curves continuously go through the change as graph 2 I - II - III. The slope of the potential function curve become smaller and smaller and becomes flatter and flatter at the original balance point S_0 . This indicates that when the evolution power of synergic development becomes stronger and stronger, the system homing power become weaker and weaker. When the evolution power is stronger than the power of maintaining original status, the system will go away from the balance status and stay in the new status. At this time, the evolution scope of the industrial-financial system synergic development ability increases and any slight changes of system internal resource factor like I, F, H, A will impact on the evolution of system synergic development ability; meanwhile, along with the effect of random fluctuation power, on the location far from the balance status, the system synergic development ability will occur none-equilibrium phase transition. In addition, with the appearance of the continuous change of external parameter and the new instability, this process will proceed in cycle, This forms an infinite loop process which can generate new structure.

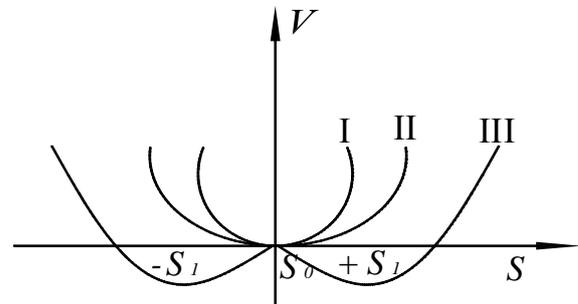


Fig.2. Nonequilibrium phase transition of industrial-financial group system synergic development ability

B. Symmetry Breaking

Although in graph 2 during the change process of system synergic development ability the potential function curve from I to III, its symmetry doesn't change, but for curve III, system status cannot be in $-S_1$ and $+S_1$ at the same time and can only chose one of them. This means the none-equilibrium phase transition actually reduces the symmetry of the original system, i.e. the Symmetry breaking occurs. In the industrial-financial synergic development ability system, the change of any resource subsystem will change the mutual relationship and the results of synergic effect, and evolve the system synergic development ability. However, different changes have different impacts on the industrial-financial group, and the results are also different. This provides various choices for the evolution direction of the industrial-financial system synergic development ability, like $-S_1, +S_1$ in graph 2. However, once one resource subsystem changes, under the effect of internal self-organization of industrial-financial system, there will be only one status for synergic development ability occurs, which makes the potential function becomes extreme dissymmetry, i.e. Symmetry breaking.

C. 4.3 Bifurcation Phenomenon

Along with the process of phase transition, the potential function curve gradually evolves from one balance status solution S_0 into the two extremums $-S_1, +S_1$ at the critical point, this phenomenon is called bifurcation. As shown in graph 3, we express balance point S as the function of $(-K + G)$. When $G < K$, $S_0 = 0$; when $G > K$, there is bifurcation phenomenon. In the graph, a_0 indicates the original status; $a_0 - a_1$ indicates that the order parameter of industrial-financial group starts to departure the balance status and in the none-equilibrium linear region; a_1 indicates the bifurcation point, i.e. the unstable point of the old structure. The fluctuation effects of the external market, economy and politics will zooming the industrial-financial group system synergic development ability through the self-organization process of internal resource system and bring the industrial-financial system evolve into a new ordered structure, i.e. the two bifurcations $a_1 - b_1$ and $a_1 - b_2$ in the graph represent the two different status of industrial-financial group system after zooming caused by the changes of different resource systems. For the system synergic development ability on any of the two bifurcations, it has the functions of self-adaptive and self-stable function, this means that it not only have the function to maintain and keep the updated states, but also has the exploratory self-organization function to promote the growth of industrial-financial group. When the external environment changes, i.e. under the effect of random fluctuation, the synergic development ability will jump from a certain level into a higher level, as b_1 in the graph turnout $c_1, c_3 \dots$, and finally promote the industrial-financial group system into a senior ordered status. Accordingly, the development process after the industrial-financial alliance exist many possible ends. If the company chose a wrong strategy or have execution error, it is likely to cause the difference of resource synergy

degree, eventually bring losses and synergic risks to the company.

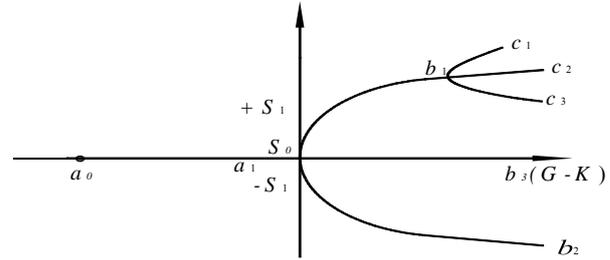


Fig.3. Bifurcation phenomenon of the evolution of industrial-financial group system synergic development ability

V. CONCLUSION

The ability of synergic development on Industrial-Financial Group System is a four-dimensional structure ability which is consisted of industrial capital, financial capital, human resource capital and intangible capital. Its formation and evolution is the results of mutual existence, mutual affections, mutual influence and mutual synergy among the internal subsystems. The evolution direction, speed and level of industrial-financial group system synergic development ability is generally determined by the subsystem synergic development status, four-dimension structure integrated matching ability and the random fluctuation factor of external environment. What's more, the ability of synergic development on Industrial-Financial Group System is the order parameter of industrial-financial group system and its evolution process is the procedure of potential function and none-equilibrium phase transition. Therefore, in order to improve the ability of synergic development on Industrial-Financial Group System, it must form synergic effect of dynamic integration and synergic operation of the structural subsystems such as industrial capital, financial capital, human resource capital and intangible capital. Then it will bring the system from chaos state into ordered state, from low grade ordered to senior ordered and promote the formation, evolution and operation of the self-organization of the ability of synergic development on Industrial-Financial Group System. Finally, it can expedite the value promotion and sustainable development of industrial-financial group system.

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