Improve the Incentive Mechanism Base on Boxed-pigs Game Model

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Abstract. An effective incentive mechanism is very important for all countries and companies, whether it is the innovation incentive mechanism for small and medium-sized enterprises or the work incentive mechanism for employees. However, the general incentive mechanism will have the problem of ineffective incentive, which needs to be improved and optimized. The failure of incentive mechanism will lead to the lack of enthusiasm of small and medium-sized enterprises that have no competitive advantage in technological innovation, and will also lead to the lack of work motivation of employees, resulting in low work efficiency and other problems. This paper analyzes real life cases through the theory of the Boxed-pigs game model. The boxed-pigs game is a classic example of a failed incentive mechanism. The big pig and the small pig in the model vividly represent the two opposing roles in real life. In different situations, the big pig and the small pig will make different strategies. By changing the conditions in the model and considering the reality, we can get solutions to improve the actual problems, such as tax incentives, employee compensation incentives, etc. Hope to improve the ineffective incentive mechanism.

Keywords: Boxed-pigs game; incentive mechanism; medium-sized enterprises; motivation of employees.

1. Introduction

1.1 Research Background and Motivation

In the process of rapid economic growth and vigorous development in various countries, the technological innovation of small and medium-sized enterprises and the enthusiasm of enterprise employees are very important core influencing factors. But in real life, there are many inefficient or ineffective incentive mechanisms, resulting in the lack of innovation motivation and low enthusiasm of employees. As the profitability of small and medium-sized enterprises is far less than that of enterprises in the middle and later stages, and even in the situation of loss or just able to recover profits, leading to the lack of motivation and ability for scientific and technological innovation, making the economy relatively lack of innovative ideas and technologies, which is relatively inferior in the international market. Secondly, the low enthusiasm of employees may be caused by the low rate of return on work, poor working environment and inappropriate company management model. This reduces the efficiency of the company.

Therefore, the failure of incentive mechanism is a problem that needs to be paid attention to and solved. Potential small and medium-sized enterprises can drive the liquidity and innovation of the whole economy. Their development and expansion can replace many mature enterprises that have entered the decline period. They may dominate the development trend of the economy and become the leading enterprises of the new era in the future. Scientific and technological innovation means stronger economic strength, making domestic economies more competitive in the international market and attracting more investment and cash flows into the domestic economy. Human resources affect the production capacity and efficiency of all types of enterprises. Employees need to actively respond to the company's regulations and have enthusiasm and subjective initiative for work, thus reducing the average production cost and improving the company's competitiveness.

1.2 Literature Review

The study mainly introduces and analyzes the implementation effect of tax preferential policies, the method of encouraging enterprises to innovate in science and technology, and analyzes the impact of policies on enterprises' scientific and technological innovation from different perspectives, including human resources, synergy and technological differences. Secondly, the paper uses the sample of GEM listed companies and the description of the collected data to evaluate the policy, and also carries out descriptive statistical analysis. The conclusion is that the preferential tax policy only has a significant effect on stimulating enterprises' scientific and technological innovation input, but the incentive effect on scientific and technological innovation output is not significant. At the same time, there are differences in the tax incentive policies. Finally, the research puts forward policy reform suggestions to understand the differences [1]. This study mainly introduces the mechanism of tax policy. By analyzing the main reasons why enterprises lack the motivation of scientific and technological innovation, the author explains the importance and points for attention of formulating tax preferential policies. The government needs to formulate policies with different strength according to the different stages and characteristics of technological innovation. Secondly, the study found the defects of the policy and analyzed it from different levels of macro and micro. Then it puts forward the principles and specific policy recommendations for formulating the policy system [2]. Some research takes the incentive mechanism of enterprises as the background, introduces the advantages and disadvantages of the incentive mechanism of enterprises, and applies it to the incentive mechanism of enterprises through the introduction of the “Boxed-pigs game” model and the analysis of its improvement. Finally, it comes to the plan to improve the inefficient incentive mechanism, which is the reduction plan, the increment plan and the reduction plus shift plan [3]. This paper first introduces and analyzes the basic model of the Boxed-pigs game and the improvement scheme of the model, and combines the model with the enterprise incentive mechanism, analyzes the practical application of the improvement scheme, compares the weak to a piglet, and the strong to a big pig, thus obtaining the inspiration for the enterprise incentive mechanism. The enterprise should reasonably develop a suitable incentive mechanism, and effective application can bring a benign competitive environment and higher work efficiency [4].

1.3 Research Framework

By analyzing the actual cases and combining with the improvement of the “Boxed-pigs game” model, this paper puts forward the solutions to solve the problems of low motivation for technological innovation and low enthusiasm of employees in small and medium-sized enterprises, and finally puts forward the deficiencies and conclusions.

2. The importance of incentive mechanism

2.1 Stimulate technological innovation of enterprises

When enterprises want to carry out some scientific and technological innovation research and development, they always encounter difficulties, especially for small and medium-sized enterprises (SMEs), the problems are: The technological R&D capacity of SMEs is not strong, and the level of capital is not enough to support technological innovation. The criteria for the definition of SMEs are determined according to the employees, operating income, total assets and other indicators of the enterprise, combined with the characteristics of the industry. The applicable industries for SMEs include agriculture, forestry, animal husbandry, fishery, industry, construction, wholesale, retail, transportation, etc. The whole process of technological innovation requires a large amount of R&D costs, time costs and human resources. From project startup to application production, investment in the market requires strong financial support [3]. However, for small and medium-sized enterprises, the scale is relatively small. Therefore, human and material resources are relatively weak, making the process of R&D and independent innovation more difficult, obtaining information more difficult, and

requiring more time costs. In addition, small and medium-sized enterprises have relatively small business scale, and their profits are far less than those of large enterprises. It is difficult to obtain corresponding financial support for the start of the project, making it impossible to carry out and implement the project. As a result, for SMEs with relatively weak indicators, technological innovation is undoubtedly a huge cost expenditure. Therefore, to establish an effective incentive mechanism becomes really essential.

2.2 Stimulate working incentives of employees

Employees belong to the human resources of major enterprises, and their work ability and enthusiasm dominate the future development potential of the enterprise. Enterprises need to encourage employees through effective incentive systems to effectively enhance the strength and production potential of the company in order to achieve enterprise goals. Usually, the employers will find it difficult to establish an incentive mechanism suitable for his own enterprise. Therefore, how to establish an incentive mechanism has become an important issue [4]. “Boxed-pigs game” is a classic game of Nash equilibrium, which is also a typical example of incentive mechanism failure. The background setting is there is a big pig and a little pig in the pigsty. One end of the pigsty has a pig feed tank, and the other end is equipped with a button to control the supply of pig food. Press the button, 10 units of pig food will enter the tank, but whoever presses the button will pay 2 units of cost first. The button is in the opposite position to the pig food tank. The pig who presses the button will pay 2 units of cost and lose the opportunity to eat at the tank first. No matter who runs to the bar and then comes back to eat, it will consume energy. Moreover, the pigs guarding the trough take advantage of it and can eat food first. There are four scenarios.

First, little pig and big pig don't press the button. No one has anything to eat. Their payoff is all zero.

Second, little pig press button, big pig does not. Suppose that no matter big pig or little pig, one run costs 2 and one run costs 10 portions of food. Little pig went to the press the button to consume 2. When little pig came back to eat, the big pig had eaten 9, and little pig only got 1. So, the little pig’s payoff is - 1, and the big pig’s payoff is 9.

Third, little pig and big pig press the button. The consumption was all 2. The big pig ran fast and ate more. When it came back, it ate 7 and the little pig ate 3. Then the little pig's payoff is 1 and the big pig's payoff is 5.

Forth, the big pig presses the button, but the little pig doesn't.

The payoff matrix is shown in table 1. The Nash equilibrium of this game is when the big pig presses the button and the little pig just wait for the food. This phenomenon of “big pig running while little pig lying down" is called “Free-riding” in economics. In this game, the little pig is not as strong as the big pig because of its poor physical quality, and its ability to seize food is not as good as the big pig. In reality, small and medium-sized enterprises also face the same problems in the market competition, they are not as competent as big firms. Besides, in the firms, there are always many “little pigs”, which refers to the employees who are lazy, and do not put any efforts for sharing others' achievements in group tasks. As a result, using an effective incentive mechanism becomes the most crucial problem.

Table 1. Payoff matrix

		Small pig	
		press	wait
Big pig	press	5, 1	4, 4
	wait	9, -1	0, 0

By improving the intelligent pig game model and its rules, which can make the incentive mechanism more effective and achieve the goal results. To improve the model, it is necessary to control the two most critical variables in the model: the amount of food and the distance between the button and the food to improve the failed incentive mechanism and make it more effective.

The following are examples of three model improvement methods and their results:

Plan I: Reduce the amount of food

Reduce the food to half of the original, from 10 units to 5 units, and the other conditions remain unchanged [3]. Payoff matrix is shown in Table 2. In this way, the best choice for pigs and piglets is to press the button. In this scheme, due to the reduction of food quantity, both big pigs and small pigs have to press the button. In this case, it can effectively avoid hitchhiking and urge all employees to work hard. However, this scheme is only applicable to short-term implementation. Long term implementation will lead to greater work pressure and lower enthusiasm of employees, resulting in bad results. Therefore, the improvement of Scheme I still has defects and the results are not ideal [3].

Table 2. Payoff matrix

		Small pig	
		press	wait
Big pig	press	5, 1	4, -1
	wait	4, -1	-5, -5

Plan II: Increase the amount of food

The food will be doubled from 10 units to 20 units, and the other conditions will remain unchanged [3]. The payoff matrix is shown in Table 3. In this case, due to the increase in the amount of food, it is not important for pigs and pigs to press the button at this time [5]. No matter what, they will have relatively more food to eat. Under this scheme, the cost of the enterprise will increase greatly, and it is necessary to increase the incentive mechanism for employees. However, employees will lose their enthusiasm for work even more, which not only does not play an incentive role, but also increases the cost of the company. This scheme is undoubtedly a failure, which completely violates the objectives of the scheme.

Table 3. Payoff matrix

		Small pig	
		press	wait
Big pig	press	10, 6	9, 4
	wait	9, 4	0, 0

Plan III: Reduce the amount of food and move the food position

Reduce the amount of food to 6 units at a time, and move the button to the side of the trough [4]. The person who presses the button can directly eat the food. Other conditions remain unchanged. The payoff matrix is shown in Table 4. At this time, the best strategy for pigs and piglets is to press the button, because whoever presses the button will be able to eat food, otherwise, they will starve if they do not press the button. In the enterprise, this scheme is the most effective. It can not only effectively encourage hard working employees, but also punish the lazy people, so that they cannot wait for benefits and reach the goal of formulating the scheme. The result is effective.

Table 4. Payoff matrix

		Small pig	
		press	wait
Big pig	press	10, 6	9, -1
	wait	4, 4	0, 0

The dynamic and positive economic state is the goal that every country is committed to achieving, and it needs continuous innovation and strong economic strength, of which technological innovation is a very important part. In order to promote the vigorous development of national economies, the government needs to carry out some effective market intervention to stimulate and promote various economic activities. For enterprise innovation, the government can help enterprises innovate through tax incentive policies, especially for small and medium-sized enterprises. Tax incentives can greatly

reduce the cost and risk of developing and innovating technologies and products, thus improving the innovation ability of small and medium-sized enterprises.

3. Results and Discussion

3.1 Government intervention - tax incentive policy

Tax incentives are given to specific groups and enterprises by giving them some special preferential tax benefits, usually by reducing tax rates and reducing or exempting taxes, thus reducing the cost of small and medium-sized enterprises to do market research, scientific research experiments, and technological innovation, making enterprise innovation results more significant and effective. While implementing the policy, the government needs to set up strict interpretation regulations to ensure the effectiveness and openness of the policy. For example, South Korea has formulated a series of relevant laws such as the Technology Development Promotion Law, the Tax Reduction and Exemption Control Law, the Tax Exception Restriction Law, and the Special Consumption Tax Law for promoting technology research and development institutes [6,7].

From the micro perspective of economics, as a company manager, it is necessary to establish effective employee incentive policies to promote the enthusiasm of employees and the sense of belonging of the company. They can encourage employees to work hard and improve the quantity and quality of output in different ways through different levels of employee incentive mechanism, so as to improve the production efficiency and interest rate of the enterprise [8].

3.2 Employee incentive mechanism:

3.2.1 Work reward return

Reward incentive refers to improving salary or wage to drive employees' work enthusiasm [9]. Through F.W. Taylor scientific management theory, Taylor deduced in a scientific way that "people are only motivated by money" [10]. This can prove the importance of money for employee incentive. Although the theory is too absolute and one-sided, work reward is indeed an indispensable part of the employee incentive mechanism.

3.2.2 Job satisfaction and sense of achievement

Herzberg identified two group of factors that motivate employees at work [11]. One of the factors groups is Motivates, which mainly concludes the work’s responsibility, advancement and achievements for the workers, etc. Therefore, managers should actively encourage employees to allocate work reasonably, which could be achieved by job enrichment.

3.2.3 Corporate culture and system management

Another group of factors in Fredrick Herzberg-two factor theory is hygiene factors, which includes working conditions, relationships with others, supervision and company policies, etc. Therefore, a good working environment and reasonable company rules and regulations are essential for employee incentive [11]. Thus, promoting the corporate culture, employees have a stronger sense of belonging to the company and are more willing to work for the company.

4. Conclusion

In various countries and their enterprises, there are more or less inefficient incentive mechanisms. Ineffective incentive mechanisms will reduce the motivation of enterprise innovation and the work efficiency of employees. The human resources of emerging enterprises and enterprises in various countries are the main driving force of national economic development, and are the key core part. Therefore, the inefficient incentive mechanism is a problem that needs to be paid attention to and solved. This paper analyzes the innovation ability of small and medium-sized enterprises by improving the various settings in a failed incentive mechanism model, and finds out the problem of

low enthusiasm of small and medium-sized enterprises in technological innovation. The government can help small and medium-sized enterprises promote innovation projects through tax incentive policies, thus improving their enthusiasm. Additionally, this paper proposes a more effective incentive plan for employees from different perspectives. Firstly, work reward return, which improves employees' enthusiasm through the most direct form of reward incentive. Secondly, job satisfaction and sense of achievement, which motivates employees through indirect psychological factors, and thirdly, corporate culture and system management, which drives employees through the influence of external factors, improve employees' initiative and sense of belonging. This paper mainly analyzes and solves the problems that may exist in small and medium-sized enterprises and their employees. The solutions are applicable to the plans that governments of various countries can refer to when formulating incentive mechanism policies, and also to the company's director or management team as a reference when improving the incentive mechanism of enterprises. The research in this paper also has some shortcomings: the solution method proposed in this paper ignores the difference of the impact of tax incentives on technological innovation of small and medium-sized enterprises. Governments have different efforts to disseminate and implement preferential tax policies. Therefore, there are regional differences in the impact of policies on enterprises in different countries or regions. Besides, there are also differences in the effect of tax preferential policies on private enterprises and state-owned enterprises. Compared with private enterprises, the response effect of state-owned enterprises is not so obvious, and may even be invalid. They will still lack the motivation and enthusiasm for technological innovation. It can be seen that there are differences in the implementation results between the two. It is hoped that in the future more in-depth and detailed research, the above problems can be avoided, and the incentive mechanism under different circumstances should be analyzed more comprehensively, so as to obtain more targeted and effective improvements.

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