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Vicious Competition Trap of Tournament Incentive and Its Correction

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Abstract: *Tournament theory is widely used in the promotion field because of its advantages such as high incentive intensity. However, the theory inevitably has many defects, one of them is that the promotion game participants fall into the vicious competition trap. The theoretical model of this paper shows that under the tournament promotion mechanism, the design of promotion rules is very important to the performance of enterprises. To avoid vicious competition between employees for promotion, this paper believes that enterprise managers can consider adding some indicators related to the overall interests of the enterprise organization when formulating the promotion rules of employees.*

Keywords: *Promotion Game, Tournament theory, Prisoner's dilemma, Incentive effect*

1. Introduction

Tournament theory is the application of game theory in the research of principal-agent relationship. This theory was first put forward by Lazear and Rosen in 1981. It has the advantages of reducing the influence of various uncertain factors, reducing supervision costs, improving performance output, and increasing incentive intensity. According to the traditional economic theory, the agent's salary is determined by the size of its marginal output. The better the agent's performance and the higher the marginal output, the higher the salary will be. However, this system can be implemented on the premise that the principal's supervision of the agent's work is credible and low-cost. But in reality, the principal's supervision of the agent's behavior is not credible in many cases and the cost may be very high. At this time, agents will make opportunistic behavior for their own interests, which makes it infeasible for the principal to determine the salary according to the agent's marginal output. The tournament theory provides a solution to this problem of salary determination, the theory determines the salary according to the relative position of agents (i.e. contestants) rather than the absolute output. The higher the relative position, the more salary the agent will get, which not only reduces the supervision cost of the principal to the agent, and by promoting competition among agents for relative positions, it can also improve the incentive intensity and make the agent work harder for the principal. Because of these advantages of tournament mechanism, this theory is widely used in many fields, such as the promotion of enterprise employees, the promotion of local officials, the promotion of university researchers and so on.

Just like many things in the world, although the tournament theory has the above advantages and is widely used, it still has some shortcomings. Generally speaking, in a promotion game, a higher-level position will face multiple lower-level competitors, that is, only a limited number of people can be promoted, the increase of one person's promotion probability will reduce the chance of another person's promotion. According to the tournament theory, employees in higher-level positions will generally receive higher wages, more respectable status, and dignity. Thus, under this mechanism, one person's gain means another person's loss. In other words, the enterprise employees in the tournament promotion game are faced with a zero-sum game. Under these circumstances, employees will be highly motivated to take the behavior of harming others and benefiting themselves for their own interests and to obtain greater promotion opportunities. If many employees take the behavior of harming others and benefiting themselves, that is, employees fall into the trap of vicious competition. Under this condition, it is difficult to maximize the overall profit of the enterprise, which fall into the prisoner's dilemma of the conflict between individual rationality and collective rationality. For enterprise managers who pursue the maximization of enterprise profit, this result is what they do not want to see.

In view of the vicious competition trap that the above tournament promotion game may fall into, this paper tries to put forward a solution to solve this dilemma by establishing a model, hoping to make better

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use of the tournament mechanism for the principals of enterprises or governments in the process of incentivizing agents and avoid too much negative influence from it.

2. Literature review

Tournament theory analyzes the incentive mechanism of principal-agent relationship in corporate management, which was first proposed by Lazear and Rosen in 1981. The principal of the company usually implements a different salary reward mechanism for agents with different abilities. However, due to the high information cost and supervision cost, in the process of actual operation, the principal will determine who can be promoted by investigating the relative performance rather than the absolute performance of the agent.[1] In recent years, domestic scholars are also studying tournament theory in combination with practical applications. On the basis of summarizing the previous literature, Qiu weinian studied the incentive of the salary gap between the internal senior management teams to the members of the senior management team, he believes that increasing the salary gap between the senior management teams can reduce costs and provide strong incentives for agents consistent with the interests of the principal.[2] Wang Yongle and Wu Jizhong introduced collectivism and high power distance into their research on enterprise performance in China. Through empirical test, they believe that the salary gap between employees at different organizational levels is positively correlated with enterprise performance, This result supports the championship theory, while the employee salary gap within the same organizational level is not or negatively correlated with enterprise performance, The result is in line with the expectation of behavior theory.[3] Zhang Hong and others confirmed the existence of tournament competition within the company with the personnel data of a company for 13 years, that is, the improvement of the employee's own output level will increase his promotion probability, while the improvement of other people's output level will reduce the employee's promotion probability. In addition, they also used data to test the impact of risk on promotion reward.[4] In view of the long-standing problem of the coexistence of high quantity and low quality of academic papers in China's academic circles, Liu Haiyang and others believe that this impetuous phenomenon is rooted in the Academic Tournament mechanism implemented under information asymmetry. They described the above characteristics by establishing a two-stage Title competition model and find that the real prosperity of China's academic circles depends on peer review and the establishment of tenure system. [5] Yan Wei and Yang Jinlan summarized the research status of tournament mechanism from three aspects: theoretical research, empirical test, and related application, and summarized and put forward five deficiencies of the theory. [6]

As for the tournament theory, many domestic scholars have researched it in combination with the promotion of local officials in China. Zhou Li'an used the tournament mechanism to explain the long-standing phenomenon of protectionism and redundant construction among local governments in China during the Economic Transition Period of China.[7] Through the research on the Promotion Tournament, he believed that the Promotion Tournament is an important source of China's economic miracle, but it also has some defects, such as the distortion of incentives, the transformation of government functions, etc. These problems make the application of this theory facing an important transformation.[8] The tournament mechanism has been used to encourage the promotion of officials before the reform and opening-up of China. Through the investigation of the central-local relations during the Great Leap Forward, Zhou Feizhou pointed out that the highly centralized control will not only lead to the emergence of the tournament system, but also lead to the failure of the tournament. [9] Through field investigation, Chen Tan and Liu Xingyun found that under the promotion tournament system, the promotion of grass-roots government officials is often the result of multiple reasons include surface and background factors. Factional relations, political background, social network, and other background factors can often affect the promotion of grass-roots cadres.[10]

From the current research situation, because the tournament theory has the basic feature of paying attention to the relative rank of agent’s job performance, as a result of this, no matter which field scholars apply the tournament theory to study, they basically admit that the tournament theory will produce the adverse consequences of vicious competition between agents, which we call the vicious competition trap of tournament theory. However, as for how to get rid of this trap, the academic circles have not put forward an ideal solution. This paper establishes a simple model to analyze the internal causes of vicious competition under the tournament theory and tries to provide an idea to improve the design of incentive mechanism, so as to avoid vicious competition between agents and promote them to strengthen cooperation, finally realize the maximization of collective interests.

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3. Problem description

In an enterprise, multiple employees at the lower level must carry out a fierce zero-sum game in order to compete for limited number of senior positions, that is, a few people who get promoted are based on others who have not been promoted, and the intensity of competition is directly proportional to the number of people participating in the competition. So, what impact will the promotion tournament system have on employees' behavior? If getting a promotion or not makes little or no difference to the employee, vicious competition will not occur among employees in the same position, and vicious competition will also bring many costs, such as the decline of the overall performance of the company, the damage to the feelings between employees, and the consumption of employees' time and energy. These shortcomings can be avoided if employees don't care if they get promoted or not. But in the reality, the problem is that whether employees can get promotion not only reflects their own ability and value, but also relates to their status and dignity. More importantly, as the competition become more and more fierce, the salary gap of employees at different level of position will become larger and larger, this is also directly related to the economic interests of employees in the material world. Generally speaking, the salary increase brought by employees' promotion will increase with the increase of promotion difficulty. Therefore, to get a higher salary and reflect their self-worth, employees will tend to act at the expense of others to improve their performance rank and win a limited promotion quota under the promotion tournament system.

The reason why the fiercer the promotion competition is, the greater the salary increase brought by promotion can be explained by the following model:

Lazear and Rosen assume that there are two homogeneous employees in the same position, recorded as employee 1 and employee 2, and their output equation is:

$$q_i = \mu_i + \epsilon_i, i \in \{1,2\} \tag{1}$$

In the above equation, q_i represents the output of employee i, μ_i represents the employee i's level of effort, ϵ_i represents random disturbance term, Suppose the competitive wage contract given by the company is (W_1, W_2), W_1 represents the salary of the successful employee who is promoted, and W_2 is the salary of the loser who is not promoted. Therefore, $W_1 - W_2$ represents salary increase brought by promotion, namely promotion reward. The effort cost of employees is $C(\mu)$, $C(\mu)$ satisfy $C' > 0$ and $C'' > 0$. Assuming that the employee is risk neutral, in this case, the optimization problem of employee I is:

$$MaxPW_1 + (1-P)W_2 - C(\mu_i) \tag{2}$$

In the above formula, P is the probability that employee i wins in the promotion game. It can be known from the first-order derivation of employee optimization problem:

$$(W_1 - W_2)\frac{\partial P}{\partial \mu_i} = C'(\mu_i) \tag{3}$$

This first derivative equation is the employee's decision equation, it includes three parts: $(W_1 - W_2)$ represents promotion reward, $\partial P/\partial \mu_i$ represents the marginal impact of the employee's effort on the employee's promotion probability. $C'(\mu_i)$ on the right of the equal sign is the marginal cost of employees' efforts.

It can be seen from the homogeneity and symmetry of employees that $\mu_1 = \mu_2 = \mu^*$ at the equilibrium state. Suppose the price of the company's products is V, and the company is risk neutral. In the social optimal state, the salary contract formulated by the company makes the marginal output of the employee's optimal input equal to its marginal cost: $V = C'(\mu^*)$, This means that the salary contract formulated by the company should meet:

$$(W_1 - W_2)\partial P/\partial \mu_i = V \tag{4}$$

This equation is the optimal decision-making equation when the company reaches the social optimal state.

Therefore, assuming that the price V of the company's products in the market is fixed, the promotion reward $(W_1 - W_2)$ is negatively correlated with the marginal impact $\partial P/\partial \mu_i$ of employees' effort on promotion probability, when the competition between employees becomes more and more fierce, if the employee's effort remains the same, it will be more difficult for them to win the competition and get promotion than before, in other words, the more intense the competition among employees, the smaller the value of $\partial P/\partial \mu_i$ will become. Therefore, to maintain the optimal decision equation (4), the

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company's managers will choose to increase $(W_1 - W_2)$, that is, increase the salary increase that employees get when they get promoted.

Through the above analysis, it can be seen that with the intensification of competition, the managers of the enterprise will increase the promotion rewards for employees, which will lead to the expansion of the income gap between employees who have been promoted and those who have not been promoted, which in turn will further aggravate the competition among employees. Under the tournament mechanism, the intensification of competition will eventually evolve into vicious competition between employees at the expense of others. From the perspective of the overall interests of the enterprise, strengthening cooperation among employees is an ideal state. Under the promotion system, on the one hand, employees will work hard for their own promotion, improve their work performance, and make themselves more likely to stand out in the competition with colleagues in the same position; At the same time, on the other hand, employees should also cooperate with each other for the overall interests of the enterprise under the requirements of the leaders, and strive to maximize the profits of the enterprise. Obviously, there is a contradiction between the objectives of these two aspects. But in reality, when facing conflict, employees will generally focus on the first goal for their own interests, which can also explain that in reality, to promote, enterprise employees are more likely to intrigued against each other and vicious competition than mutual cooperation. In the promotion game between local officials, local officials in the tournament competition are also faced with two competitive objectives. First, they compete for the economic output and tax revenue of their region, and second, they compete for their own political promotion (improve their relative ranking with officials in other regions in terms of ruling performance).

We can use a payoff matrix of prisoner's dilemma to express this kind of uncooperative behavior more intuitively among enterprise employees under the tournament system. Suppose that two homogeneous employees 1 and 2 in the same position compete for the same higher position. The payoff matrix is as follows. The numbers in the payoff matrix are only for more intuitive explanation of the problem and have no practical significance.

Table 1: Payoff matrix.

E1 / E2	Uncooperative	Cooperative
Uncooperative	5,5	10,3
Cooperative	3,10	8,8

In this payoff matrix, (Uncooperative, Uncooperative) is a Nash equilibrium. When employee 1 chooses "Uncooperative", employee 2 will get 5 benefits from choosing "Uncooperative" and 3 benefits from choosing "Cooperative", when employee 1 chooses “Cooperative”, employee 2 will get 10 benefits from choosing “Uncooperative” and 8 benefits from choosing “Cooperative”, so "Uncooperative" is the best choice for employee 2; When employee 2 chooses "Uncooperative", employee 1's benefit from choosing "Uncooperative" is 5 and the benefit from choosing "Cooperative" is 3, when employee 2 chooses “Cooperative”, employee 1’s benefit from choosing “Uncooperative” is 10 and the benefit from choosing “Cooperative” is 8, Therefore, "Uncooperative" is also the best choice for employee 1. It should be noted that the "Un cooperation" here includes all the possibilities of "Uncooperative", including not only the two employees who do their own work, do not contact and interfere with each other, but also the vicious competition between the two employees. According to the definition of Nash equilibrium, (Uncooperative, Uncooperative) is a Nash equilibrium of prisoner's dilemma game. In fact, (Uncooperative, Uncooperative) is also the only Nash equilibrium in the prisoner's dilemma game. However, it is not difficult to see from the payoff matrix that (Cooperative, Cooperative) is the best choice for the whole enterprise, because when two employees choose to cooperate, the overall income of the enterprise is 16, which is not only greater than the income 10 when both employees do not cooperate, but also greater than the income 13 when only one employee cooperates, and the other employee does not cooperate. Therefore, for enterprise managers, the original intention of adopting the Tournament mechanism is to encourage employees to work harder and bring greater benefits to the enterprise, but the reality is often counterproductive.

4. Basic model

This section attempts to establish a simple model to explain the internal motivation of enterprise employees to choose non cooperative behavior under the Tournament mechanism, and then try to modify the model to encourage employees to actively cooperate. This model is an extension of Zhou Li'an Tournament model.[7]

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We still assume that in an enterprise, there are homogeneous employees 1 and 2 with the same position competing for the same higher-level position. The personnel department of the enterprise evaluates their work performance, and the employees with good performance will get the only chance for promotion. The relationship between each employee's efforts and their work performance can be expressed by the following formula:

$$y_i = a_i + ra_j + e_i \ \ (i = 1,2; i \neq j) \tag{5}$$

In the above formula, y_i represents the work performance of employee i, For example, it can be the number of products produced or sold by employee i per unit time, which is characterized by easy measurement and comparison; a_i represents the working effort of employee i, a_j represents the working effort of employee j, r represents the influence coefficient of employee j's efforts on employee i's work performance. The value range of r is assumed to be $-1 < r < 1$, This means that no matter whether the externality of employee j's efforts on employee i's performance is positive or negative, the impact of any employee's behavior on his own performance will always exceed that on others' performance. We call the externality of his own efforts on others' performance as employee j's spillflow effect on employee i. e_i is a random disturbance term, and e_i and e_j are independent of each other. We assume that $e_j - e_i$ obeys a symmetric distribution F with an expected value of 0, independent and identically distributed. Due to the asymmetry of information, the enterprise personnel department cannot accurately understand the effort of each employee, but as mentioned above, the performance y_i of each employee is easy to measure and compare, so the incentive mechanism that the enterprise personnel department adopt can only be based on observable work performance.

It is assumed that the promotion rules of the Tournament mechanism of the enterprise are: If the work performance of employee i exceeds that of employee j, i.e. $y_i > y_j$, then employee i will be eligible for promotion and obtain the utility level of V, at this time, employee j cannot obtain the promotion qualification and can only obtain the utility of $v(V > v)$.

For $i \neq j$, the probability of employee i being promoted can be calculated as follows:

$$Prob(y_i > y_j) = Prob[a_i + ra_j + e_i - (a_j + ra_i + e_j) > 0] = Prob[e_j - e_i < (1-r)(a_i - a_j)] = F[(1-r)(a_i - a_j)] \tag{6}$$

So, the utility function of employee i is:

$$U_i(a_i, a_j) = F[(1-r)(a_i - a_j)]V + \{1 - F[(1-r)(a_i - a_j)]\}v - C(a_i) \tag{7}$$

Here $C(a_i)$ refers to the cost that employee i needs to pay due to hard work, and it is assumed that $C' > 0, C'' > 0$.

Take the partial derivative of the above formula to a_i, and obtain the first-order condition for maximizing the utility of employee i:

$$(1-r)f[(1-r)(a_i - a_j)](V - v) = C'(a_i) \tag{8}$$

Since we assume that $(e_i - e_j)$ follows a symmetric distribution with an expectation of 0, under the condition of symmetric Nash equilibrium, $a_i^* = a_j^*$, therefore, the above first-order condition becomes:

$$(1-r)f(0)(V - v) = C'(a_i) \tag{9}$$

From the perspective of the whole enterprise, under the optimal arrangement of the whole enterprise, we will choose a_i and a_j to maximize the overall interests of the enterprise. At this time, for $i \neq j$,

$$Max(1 + r)(a_i + a_j) - C(a_i) - C(a_j) \tag{10}$$

The first order condition is:

$$1 + r = C'(a_i) \tag{11}$$

Comparing the two first-order conditions (10) and (11), it can be found that under the optimal condition of the enterprise (formula 11), The larger r means that employees work harder (i.e. a_i increases with the increase of r), while under the current promotion rules (formula 10), the larger r means that employees work less hard (i.e. a_i decreases with the increase of r).

That is to say, under the Promotion Tournament System, if two employees compete for the only senior position, the greater the positive externality of one employee's hard work to the performance of another

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(negative externality can be regarded as negative positive externality), namely the closer r is to 1, according to formula (10), the employee's incentive to work hard is weaker; On the contrary, if an employee has greater negative externalities to another employee's performance, that is, the closer r is to -1, according to formula (10), the employee's motivation to work hard will be stronger. Under the tournament system, employees in competition are more concerned about the relative position between themselves and competitors. In this case, competitors are not only encouraged to do things that are conducive to themselves, but also strongly encouraged to do things that are not conducive to competitors, especially those that harm others and benefit themselves. However, the desire for cooperation is relatively insufficient. For the enterprise, this vicious competition behavior of employees obviously can not maximize the interests of the enterprise.

As the above model shows, the reason why employees will compete maliciously lies in the defects in the design of incentive mechanism. Next, we try to modify it. The above promotion rule is that the personnel department of the enterprise compares the job performance y_1 and y_2 of the two employees, and according to their relative ranking, the employee with higher job performance will be eligible for promotion. Now, under the championship promotion mechanism, we need to design a more effective promotion rule s to make it meet that when $s_i > s_j$, employee i can win the competition, and ensure that under the first-order condition, the greater r, the more motivated employees will be to work hard. It should be noted that when r is greater, namely the positive externality of employees' efforts is greater. At this time, it means that the cooperation between employees is easier, in other words, the harder employee i is, the more help it will objectively give to employee j's performance. Therefore, in this process, on the one hand, employees work hard for their own promotion, on the other hand, they objectively contribute more benefits to the enterprise through cooperation and realized incentive compatibility.

The revised promotion rules can be designed as follows:

$$s_i = y_j + ka_i (k > 0) \tag{12}$$

$$s_j = y_i + ka_j (k > 0) \tag{13}$$

When $s_i > s_j$, employee i is qualified for promotion and obtains the utility level of V, while employee j is not qualified for promotion, and can only obtain the utility of v, $(V > v)$. From this promotion rule, we can find that the promotion opportunity of each employee is not only positively related to their own efforts, but also positively related to the performance level of their competitors. Therefore, this can better motivate the employees to cooperate, to bring greater benefits to the whole enterprise.

For $i \neq j$, the probability of employee i obtaining promotion qualification can be calculated as follows:

$$Prob(s_i > s_j) = Prob[y_j + ka_i - (y_i + ka_j) > 0] = Prob[a_j + ra_i + e_j + ka_i - a_i - ra_j - e_j - ka_j > 0] = Prob[e_i - e_j < (1 - r - k)(a_j - a_i)] = F[(1 - r - k)(a_j - a_i)] \tag{14}$$

Therefore, the utility function of employee i is:

$$U_i(a_i, a_j) = F[(1 - r - k)(a_j - a_i)]V + \{1 - F[(1 - r - k)(a_j - a_i)]\}v - C(a_i) \tag{15}$$

Take the partial derivative of the above formula with respect to a_i, and the first-order condition for maximizing the utility of employee i is obtained as follows:

$$(r + k - 1)f[(1 - r - k)(a_j - a_i)](V - v) = C'(a_i) \tag{16}$$

Since we assume that $(e_j - e_i)$ follows a symmetric distribution with an expectation of 0, under the symmetric Nash equilibrium, $a_i^* = a_j^*$, therefore, the above first-order condition becomes:

$$(r + k - 1)f(0)(V - v) = C'(a_i) \tag{17}$$

At this time, as r increases, that is, the greater the positive externality of employees' efforts on the performance of their competitors, employees will work harder, so this promotion rule will not lead to vicious competition between employees at the expense of others, but is conducive to the overall interests of the enterprise. While pursuing personal promotion qualification, employees' personal goals objectively promote the overall interests of the enterprise and can realize incentive compatibility.

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5. Recommendations and conclusions

In order to better play the role of the promotion tournament mechanism and avoid vicious competition among agents in the process of striving for position promotion, this paper puts forward the following suggestions according to the previous analysis:

First, when designing the promotion rules, the rule makers should add some indicators related to the overall interests of the enterprise. For example, in the previous section, we added the performance of employee's competitors to the revised promotion rules. In this way, agents can be encouraged to act in the direction most conducive to the overall interests while working hard for their own promotion purpose, so as to realize incentive compatibility. System has a strong incentive and restraint effect. It stipulates what people can and cannot do. A good system can make bad people better, while a bad system will make good people worse. Therefore, designing reasonable promotion rules is very important to the interests of the principal and the whole enterprise.

Second, the principal needs to strengthen the supervision of the agent's behavior, take punitive measures for the agent's vicious competition at the expense of others, and increase the cost of the agent's noncooperation; Reward the agents who actively cooperate and are willing to contribute. However, due to the limited rationality of the principal and the existence of information asymmetry, the principal also needs to pay a certain cost for the supervision of the agent, such as the time cost of the principal and the cost of installing monitoring. Therefore, the principal needs to weigh the supervision cost and the income brought by the agent's efforts to cooperate, so as to maximize the overall interests of the enterprise, When the marginal supervision cost of the principal is equal to the marginal income of the agent's efforts, the interests of the enterprise are maximized.

Third, from the perspective of informal rules, the principal can also encourage the agent to cooperate and actively contribute to the collective by strengthening the ideological and moral education of the agent, strengthening the construction of corporate culture, and carrying forward the value of "personal interests subject to collective interests". However, informal rules are not mandatory, and their binding force is relatively insufficient compared with formal rules such as legal provisions and rules. In reality, when facing the conflict between personal interests and collective interests, most people will still focus on personal interests. Therefore, the effect of this practice has obvious limitations and can only be used as a supplement to the formal system.

Promotion tournament system has the advantages of reducing the influence of various uncertain factors, reducing supervision costs, improving the output of corporate performance, and increasing incentive intensity. However, due to the attention to the relative position of agents, there are also defects that lead to vicious competition. The main contribution of this paper is that through model analysis, we find that when the principal uses the tournament mechanism to select the agent to be promoted, the design of promotion rules directly affects the behavior of the agent. In order to the overall interests and avoid agents falling into the trap of vicious competition, the promotion rules need to include indicators related to the overall interests of the enterprise. At the same time, the principal's supervision and ideological and moral education of agents can also limit the vicious competition between agents. Because the specific situation of different organizations is more complex, what this paper adopts is only a simple and general model. When encountering more complex enterprise organizations, it also needs to carry out specific analysis according to specific problems.

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