How to Promote Cooperation in the Case of "Voluntary Salary cut"

-Based on Repeated Game Model

Siyi Chen

College of Economics and Management, China Agricultural University，Beijing, China

Chensy4141@163.com

Abstract. In 2022, several companies in Shenzhen encouraged their employees to"voluntarily" cut their salaries to cope with the operational difficulties, which caused general anxiety among employees. In order to explore how to avoid the involution of "bidding for salary cut" and protect the overall treatment and employment environment of employees, this paper analyzes the case of "voluntary salary cut" from the perspectives of one-time game, limited repeated game and infinite repeated game based on the repeated game model. The conclusion shows that when employees pay full attention to safeguarding the long-term interests of the overall employment treatment, they can achieve a cooperative situation in which all employees do not reduce their salaries. Based on this result, this paper puts forward some simple suggestions for enterprise employees and enterprise decision makers.

Keywords: epeated Game Model；Voluntary Salary cut

1 Introduction

In 2022, the operating pressure of small and medium-sized enterprises has generally increased due to the epidemic. In order to reduce management and labor costs, Guangzhou Duoyi Network Co., a firm in Shenzhen encourage employees to "voluntarily reduce their wages": It require employees who are willing to reduce their wages to fill in a commitment letter and submit it separately, thus reducing the operating burden of enterprises. This has caused widespread anxiety among employees. On the surface, enterprises encourage voluntary behavior, but in fact, they form an involution behavior of "bidding for salary cut", encouraging employees to compete to provide lower-paid services, leading to a general decline in employee treatment [1].

From the perspective of employees, this has caused a social dilemma similar to the prisoner's dilemma among employees: employees are unwilling to bear the loss of salary cut, but if they do not take the initiative to reduce their salaries, they may face the risk of being ignored by the leaders or even being laid off if other employees take the initiative to reduce their salaries; If all employees voluntarily reduce their salaries, they will avoid risks in the short term, but in the long run, they will cause a general decline

in wages and promote the degradation of the employment environment. Obviously, the situation that employees all choose "unwilling to reduce salary" not only guarantees the salary and avoids the risk of being laid off, which is undoubtedly a win-win situation for employees [2]. In order to reduce the behavior of enterprises sacrificing employees' interests to ensure operating efficiency, ensure employees' working treatment and protect the employment environment, this paper starts from this example and explores how to achieve a cooperative situation in which employees do not take the initiative to reduce their salaries from the perspective of repeated games based on previous research [3].

2   Game analysis

2.1   Basic assumptions

1. Suppose there are two players in the salary cut game: employee A and employee B;
2. Players A and B have two options: A and B can submit a commitment letter of voluntary salary cut to the leaders after the leaders of the enterprise put forward the proposal of voluntary salary cut or do not give feedback;
3. A，B two employees independently adopt strategies at the same time, without knowing each other's voluntary salary cut behavior, and both sides know the characteristics, strategic space and payment function of other players.
4. Payment by both sides (u_A, u_B). As shown in Table 1:

Table 1. Payoff of Player A&B

A/B	Salary cut	No salary cut
Salary cut	（1,1）	（3,0）
No salary cut	（0,3）	（2,2）

If both employees A and B voluntarily cut their salaries, they will both suffer the direct loss, but avoid the risk of being laid off, and the payoff will be 1; If one of A and B is willing to cut salary and the other isn't, the one willing to reduce salary will be recognized and reused by the leaders, with a payoff of 3, while the one unwilling to cut salary will face the risk of not being reused or even being laid off, with a payoff of; If both A and B are unwilling to cut their salaries, both sides will avoid the risk of layoffs and the loss of salary cut, and ensure the employment quality of all employees, and the payoff will be 2, that is, a cooperative situation will be reached.

2.2   Game Deduction

There are different circumstances for enterprises to encourage salary cut: some enterprises intend to directly screen out a group of employees who have high salary requirements by encouraging salary cut, so they adopt the strategy of "cut or leave" and directly lay off employees who are unwilling to reduce their salaries, so the salary cut game is only played once; Some enterprises hope to reduce the overall labor cost by regularly encouraging salary cut, so they play the game of salary cut several times. The following

analysis will cover three situations: a one-time game, a finite repeated game, and an infinite repeated game.

One-time game.

If the enterprise directly adopts the strategy of "coorperate or leave", that is, when one party reduces salary and the other party does not reduce salary, the company will directly abolish the employees of the party that does not reduce salary, so it only plays a complete information static game. It is easy to determine that the Nash equilibrium is (salary cut, salary cut), i.e., (1,1)

Finite repeated games.

If the enterprise wants to reduce the overall labor cost through multiple rounds of "voluntary salary cut", it will play a limited number of repeated games for n times. This game is analyzed by backward induction[4]: in the nth game, the equilibrium is (salary cut, salary cut); Then in the (n-1)th game, both sides know that there is no cooperation opportunity in the future, and the other side will voluntarily reduce the salary to gain the recognition of the leaders. In order to avoid the risk of being laid off, they will still choose to reduce the salary. By analogy, the two sides will always choose (salary cut, salary cut), that is, they will not reach cooperation. The result is the same as that of one-time game.

The results of finite repeated games are in line with the expectation of "Chain Store Paradox"[5]: the equilibrium results of finite repeated games are exactly the same as those of one-time games.

Infinite repeated games.

If the enterprise wants to reduce the labor cost by encouraging employees to reduce their salary for a long time, and often encourages "bidding for salary cut", it will play an infinite number of repeated games. At this time, in order to achieve a cooperative situation between employees (no salary cut, no salary cut), it is necessary to put pressure on both sides to make long-term interests superior to short-term interests, and then promote the cooperation between A and B. In order to quantitatively analyze this game, the following assumptions are introduced:

1. The players have the same discount factor α (the current benefit that people are willing to pay to get one unit of the next benefit), $0<\alpha<1$;
2. Everyone adopts a "Tigger Strategy"[6]: at first, both sides choose not to reduce their salary, that is, choose cooperation; Once one party chooses to reduce salary, it will always choose to reduce salary in the subsequent game, that is, choose confrontation.
3. Both sides assume that the other side will not choose "no salary cut" first.

Therefore, in order for both parties A and B to choose (no salary cut, no salary cut), for any player, the income from choosing to reduce salary in the t-times is less than that from choosing not to reduce salary in the t-th game.

Assuming that both parties A and B choose (no salary cut, no salary cut), A chooses to reduce salary in the t and subsequent games, and B chooses to reduce salary in the (t+1)th and subsequent games.

For A:

Before the t game, the payoff of each game is 2;

The payoff of the t game is 3;

After the t game, the payoff of each game is 1.

- If A chooses "salary cut" in the t-th game, the payoff of A is:

$$W_1 = 2 \times (1 + \alpha + \alpha^2 + \ldots\ldots \alpha^{t-2}) + 3\alpha^{t-1} + 1 \times (\alpha^t + \alpha^{t+1} \ldots\ldots) \tag{1}$$

$$W_1 = 2 \times \frac{1-\alpha^{t-1}}{1-\alpha} + 3\alpha^{t-1} + \frac{\alpha^t}{1-\alpha} \tag{2}$$

In A's assumption, B wouldn't choose "salary cut" first, therefore, in the t-th game, the payoff of B is 0, the total payoff of B is:

$$W_1' = W_1 - 3\alpha^{t-1} \tag{3}$$

- If A still chooses "no salary cut" in the t-th game, the total payoff is:

$$W_2 = 2 \times (1 + \alpha + \alpha^2 + \ldots\ldots \alpha^{t-2}) + 2\alpha^{t-1} + 2 \times (\alpha^t + \alpha^{t+1} \ldots\ldots) \tag{4}$$

$$W_2 = 2 \times \frac{1-\alpha^{t-1}}{1-\alpha} + 2\alpha^{t-1} + 2 \times \frac{\alpha^t}{1-\alpha} \tag{5}$$

The total payoff of B is:

$$W_2' = W_2 \tag{6}$$

However, in the actual game, both A and B have the same decision mechanism, which means that there are chances that A and B both choose "salary cut" in the t-th game. In this case, their total payoff is:

$$W_3' = W_3 = W_1 - 2\alpha^{t-1} \tag{7}$$

For either side of the game, the decision is only about whether to choose "salary cut" in the t-th game, choosing between W_1 and W_2 with different discount factor α. To sum up, for either side of the game, the total payoff in infinite repeated games depend on their choice in the t-th game. The payoff is shown in Table 2.

Table 2. Total Payoff of Player A&B in Infinite Repeated Games

A/B	Salary cut	No salary cut
Salary cut	$(W_1 - 2\alpha^{t-1}, W_1 - 2\alpha^{t-1})$	$(W_1, W_1 - 3\alpha^{t-1})$
No salary cut	$(W_1 - 3\alpha^{t-1}, W_1)$	(W_2, W_2)

For A, the decision is only about choosing between W_1 and W_2. If A values long-term payoff more, then $W_1 < W_2$, A will choose "no salary cut" in the t-th game.

Make $W_1 < W_2$:

$$2 \times \frac{1-\alpha^{t-1}}{1-\alpha} + 3\alpha^{t-1} + \frac{\alpha^t}{1-\alpha} < 2 \times \frac{1-\alpha^{t-1}}{1-\alpha} + 2\alpha^{t-1} + 2 \times \frac{\alpha^t}{1-\alpha} \qquad (8)$$

$$\alpha > 0.5 \qquad (9)$$

It is known that when $\alpha > 0.5$, $W_1 < W_2$. At this time, both players will continue to choose (no salary cut, no salary cut). Therefore, when $\alpha > 0.5$, the trigger strategy is the sub-game refined Nash equilibrium of the salary cut problem, and the cooperative situation (no salary cut, no salary cut) is the equilibrium result of each stage.

It can be seen that whether players can achieve cooperation in the salary cut game mainly depends on the discount factor, which shows that cooperation is difficult to achieve when employees pay more attention to short-term interests and are more willing to obtain short-term recognition from leaders through salary cut; On the contrary, when employees pay more attention to protecting the long-term interests of the employment environment, they are more likely to reach cooperation, thus achieving a win-win situation.

3   Conclusions and Suggestions

The Labor Law of China clearly stipulates that if the wage of an employee who has signed a labor contract is reduced[7], the enterprise shall bear the burden of proof for this, rather than orally stating that the enterprise can reduce the wage under these circumstances, and must provide proof that the production and operation status of the enterprise and the situation at the time of signing the labor contract have changed[8]. Moreover, from a legal perspective, "voluntary salary cut" also indicating coercing employees in some way.

Based on the analysis of the game model, it can be seen that, from the perspective of employees, when enterprises reduce operating costs by sacrificing employees' interests, in order to protect their reasonable rights and interests, employees should fully realize the importance of protecting the long-term interests of collective wages and salaries, so as to stand firm, refuse the involution of "competitive bidding for salary cut", restrain the decision-making mode of enterprises to cope with operational difficulties by subtracting employees' interests, and seek better for the majority of employees.

At the same time, from the perspective of enterprise decision-makers, when faced with huge operational difficulties, it can save labor costs to some extent by encouraging salary cut for a limited time; However, if we take encouraging salary cut as a regular way to reduce costs, employees may reach cooperation and resist together, and it will be difficult to take effect. In addition, enterprises' encouragement of salary cut may lead to adverse selection[9](lemon market) [10], prompting outstanding employees who do not accept salary cut to constantly change jobs, which is also a problem worthy of consideration by enterprise decision makers. To sum up, enterprises should fully consider the

interests of employees, and the strategy of encouraging salary cut is not a long-term way to overcome the operational problem.

Reference

1. Cheng Zhichao. How to lay off employees and reduce wages in enterprises under the financial crisis [J]. Sales and Market (Management Edition), 2009(02):78-80.
2. Li Ping. Analysis of Enterprise Management Decision under Game Theory [J]. Modernization of Shopping Mall, 2021 (21): 106-108. DOI: 10.14013/j.cnki.scxdh.2021.21.039
3. Zhang Fen, Li Chao, Wu Hongxing, et al. Repetitive Games under Uncertainty [J]. Practice and Understanding of Mathematics, 2020,50 (21): 291-298
4. Sima A, Mahdi A, Soroush S. Time-Of-Use pricing in an energy sustainable supply chain with government interventions: A game theory approach[J]. Energy,2022,255.
5. Tracy M W. Paradox Lost: The Evolution of Strategies in Selten's Chain Store Game[J]. Computational Economics,2014,43(1).
6. Wright J. Punishment strategies in repeated games: Evidence from experimental markets[J]. Games and Economic Behavior,2013,82.
7. Wang Pingping. Breaking through the Prisoner's Dilemma in Corporate Culture [J]. Human Resources, 2022 (07): 65-67ournal of Beihang University (Social Science Edition), 2010,23(01):15-21.
8. Chen Shuwen, Guo Diandong. Research on the Accumulation of Implicit Human Capital in Enterprises Based on Infinite Repeated Games [J]. Science and Technology Progress and Countermeasures, 2012,29 (15): 96-99
9. Ding Huang, Li Xiaofei. Adverse Selection, Interest Games, and Policy Execution Obstacles [J]. Journal of Beijing University of Aeronautics and Astronautics (Social Sciences Edition), 2010,23 (01): 15-21. DOI: 10.13766/j.bhsk.1008-2204.2010.01.002.
10. Xie Huier. A Brief Discussion on the Lemon Market [J]. Finance and Economics, 2018 (29): 19-20. DOI: 10.16266/j.cnki.cn11-4098/f.2018.19.014