

# Managerial Analysis of The Crew Labor Inspection System

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**Abstract:** The labor inspection system of competent authorities will directly affect the protection of labor rights and interests of crew members in shipping enterprises, and the essential feature of the combination of behavioral strategies of two parties is the game and interaction between the parties to maximize their own interests, however, few studies have focused on how to coordinate the strategic choices of competent authorities and shipping enterprises to achieve the most adequate protection of labor rights and interests of crew members in practice. Therefore, it is reasonable and necessary to analyze the interaction between the labor inspection strategy of competent authorities and the crew management behavior of shipping enterprises from the game perspective. To this end, we construct an evolutionary game model between the competent authority and the crew management of shipping enterprises by considering the influence of the labor inspection of the competent authority on the crew management behavior of shipping enterprises, and simulate the main factors affecting the evolutionary stabilization strategy. The results show that the key points to reduce the probability of enterprises violating labor rights and interests of crew members are: reducing the cost of investigation by competent authorities, increasing the probability of successful investigation by competent authorities, increasing the fines of shipping enterprises and improving the positive effect of monitoring by competent authorities. As a result, in order to effectively protect the labor rights and interests of crew members, the state should further improve the relevant legal system and increase the amount of compensation for shipping enterprises. The competent authorities should increase the management personnel and working expenses appropriately to reduce the cost of investigation and ensure the quality of handling cases.

**Keywords:** Crew, Labor inspection system, Management science analysis.

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## 1. Introduction

As an important talent resource of shipping industry, crew members are a special group compared with workers in other industries. The harsh working environment, high risk, high professional and technical requirements, high mobility and other characteristics of crew members have caused their physical and psychological pressure, coupled with the work of crew members involved in international trade and foreign labor, labor and social security rights and interests are difficult to get comprehensive protection. For example, the labor remuneration of crew members is often in arrears, there is a wide gap in the applicable standards of compensation for personal damages, and they cannot enjoy social insurance and welfare benefits. At present, the protection of the legitimate rights and interests of crew members has attracted wide attention from all over the world, and the protection of crew members' labor rights and interests has been the focus of attention of the International Labor Organization and an important area of research for experts and scholars from all over the world. However, there are still a lot of blind spots in both the research field and the grasp of the problem. Firstly, there are more theoretical analysis frameworks with the help of economic law and labor law, and less with the help of management perspective, which weakens the realistic explanatory power of crew labor rights and interests protection; secondly, there are more studies on crew labor rights and interests protection from the perspective of court, and less studies on crew labor rights and interests protection from the perspective of labor inspection of governmental authorities, which makes it difficult to provide reference for objective and practical protection of crew labor rights and

interests. Therefore, this paper takes the "decent labor" theory proposed by the International Labor Organization as a guide, and establishes a tripartite game model based on a full analysis of the behavior of labor supply and demand subjects, the behavior of enterprises and laborers, and the behavior of labor inspection by competent authorities, and explores the interaction between stakeholders and their internal driving force under the labor inspection policy in order to improve the supervision level of labor rights protection of crew members.

## 2. Study on the Behavior of Labor Supply and Demand Agents

Labor supply and demand include two components: labor supply and labor demand. Labor supply is the total social labor force that has participated and requested to participate in social labor, i.e. the sum of the employed and working population. Labor demand is the ability and capacity of social production process to absorb and accommodate labor force in a certain period of time. Society cannot stop consuming, and it cannot stop producing. There are two kinds of labor demand: one is the demand of social production, which is the total demand of all kinds of production in the whole society, i.e. macro demand; the other is the demand of individual enterprises, i.e. micro demand. Crew labor supply is the real condition of social reproduction of shipping industry and determines the total scale of economic activities of shipping industry.

Since the reform and opening up, the marketization of labor factor allocation in China has been increasing. From a planned economy where the labor force was assigned by the state, to a planned economy where enterprises have the

autonomy to hire and employees have the autonomy to choose their own jobs and realize employment through labor contracts, the employment mode in China has undergone a fundamental change and the market-oriented allocation of labor factors has made great progress. The main position of supply and demand in the labor market has been established. Employers of all kinds have gradually gained the autonomy to employ people, and their autonomy and flexibility to adjust employment according to market changes have greatly increased, and the vitality of enterprises has been released. At the same time, with the rapid penetration and development of new technologies such as artificial intelligence into various industries, the labor market has been changing. However, the current situation of relative oversupply of labor has not completely changed (Kong and Yu, 2021). Especially, the labor supply of general crew has far exceeded the demand (Su and Cai, 2011).

## 2.1. Analysis of the behavior of enterprises and labor

In order to compete and maximize profits, shipping companies may lower crew wages, reduce crew insurance and benefits in the shipping market, and refuse to assume corresponding social responsibilities. The crew, especially the senior crew, needs to have solid professional knowledge and rich sailing experience, and only those with good education and sailing training can be competent for this job. In addition, because crew work is hard and boring, many people are unwilling to engage in or difficult to adapt to this occupation. Therefore, crew work is generally regarded as a special job, and it is difficult for laborers from other industries to enter, which determines the relative independence and closedness of the crew labor market.

## 2.2. Analysis of the behavior of government authorities

The functions of the governmental authorities necessarily revolve around the work schedule of the local government. Governments at all levels will constantly seek a balance between "maintaining social stability" and "promoting economic development". When governments at all levels give more consideration to attracting investment for the development of the local economy and put the pursuit of economic growth in the first place, they may harbor and connive at irregularities in enterprises. Objectively, this is a certain degree of functional deficiency of the government as a representative of public interests, which neglects the protection of workers' legitimate rights and interests. On the contrary, when the government tries to achieve social stability, it tends to put the defense and protection of labor rights and interests of workers in the first place, and then strengthens the supervision of labor practices of employing enterprises and reinforces the function of labor inspection.

# 3. Multi-party Game Analysis in Labor Inspection

## 3.1. Three party game modeling

The game participants: shipping enterprises, crew members and government authorities (Zhang and Lv, 2018). It is assumed that each participant has complete information related to the game in the whole game process, and all of them can make rational choices under the objective conditions. In order to simplify the problem, it is assumed that the shipping

enterprises mainly make improper profits by infringing on the legitimate rights and interests of crew members.

First, suppose that the total wealth created by the shipping enterprise is  $M$ , and the wealth legally due to the shipping enterprise accounts for the proportion of the total wealth created by the enterprise is  $a$ . For the motive of self-interest, the shipping enterprise appropriates the  $bM$  part of the total wealth created by the enterprise according to the proportion  $b$ , so that the share of the enterprise infringing the interest benefit can be directly expressed as  $(1-a)bM$ . Use  $C_1$ . The total cost of infringement of the legal rights and interests of labor by the shipping enterprise which does not strictly implement the relevant laws, including the loss of its own interests due to the reduction of the total wealth created by the enterprise as a result of the reduction of the labor motivation of the crew, the cost of the possible legal action and the loss of reputation, etc. Obviously, when  $(1-a)bM - C_1 > 0$ , the shipping enterprise has the interest drive to plunder the legitimate rights and interests of crew members. And when  $(1-a)bM - C_1 \leq 0$ , the shipping enterprise will not implement the behavior of infringing the rights and interests of crew members.

Secondly, the crew may or may not report the abuse by the company, and the government authority will investigate the abuse by the company based on the crew's report and its own function. In order to simplify the problem, it is assumed that the government authorities will only investigate when the crew members report, and they will investigate if there is a report. In the choice of action strategy, the shipping company has two choices of action: to infringe or not to infringe the legitimate rights and interests of the crew (infringement and non-aggression); the crew and the government authorities also have two choices of action: to report or not to report and to investigate or not to investigate; and the results of investigation may also be two: to detect the infringement and not to detect the infringement.

In addition, it is assumed that  $P_1$  denotes the probability of the shipping firm committing the infringement, and  $P_2$  denotes the probability of reporting by crew members, and  $P_3$  denotes the probability of successful investigation by the labor government authority. At the same time, the probability of a violation is denoted by  $C_2$ , and  $C_3$  denotes the cost of reporting by crew members and the cost of investigation by government authorities, respectively;  $D$  denotes the amount of compensation paid by shipping enterprises to crew members for successful investigation of infringement;  $F$  denotes the fine paid by shipping enterprises to regulators for successful investigation of infringement;  $E$  denotes the positive utility (such as enhanced credibility and reputation) gained by regulators for successful investigation;  $E$  denotes the negative utility (such as weakened credibility and enhanced reputation) incurred by regulators for failed investigation.  $E$  denotes the negative utility (e.g., loss of credibility, loss of reputation, etc.) incurred by the regulator as a result of failure.

Based on the above behavioral assumptions and strategic choices, the following six game processes and outcomes may occur:

The shipping enterprise chooses to commit the infringement, the crew chooses to report it, and the government authority chooses to investigate it and succeeds in its investigation. The shipping enterprise compensates the crew for their losses  $D$  and the government authority imposes

a fine on the enterprise F. At this point, the three parties' payments are:  $-D - F - C_1$ ,  $D - C_2$ ,  $F + E - C_3$ .

The shipping company chooses to commit the infringement, the crew chooses to report it, and the government authority chooses to investigate but the investigation is unsuccessful. At this time, the payment of the three parties are:  $(1 - a) bM - C_1$ ,  $-(1 - a) bM - C_2$ ,  $-E - C_3$ . The payment of the three parties at this time is

③ The shipping enterprise chooses to commit the infringement, the crew chooses not to report, and the government authority chooses not to investigate the evidence. At this time the three parties pay respectively:  $(1 - a) bM - C_1$ ,  $-(1 - a) bM$ ,  $-E$ .

④ The shipping company chooses not to commit the infringement, the crew chooses to report it, and the government authority chooses to investigate it and succeeds in doing so. At this time, the three parties' payments are 0, respectively,  $-C_2$ ,  $-C_3$ .

⑤ The shipping company chooses not to commit the infringement, the crew chooses to report, and the government authority chooses to investigate but is unsuccessful in doing so. At this time, the three parties' payments are 0, respectively,  $-C_2$ ,  $-C_3$ .

(6) The shipping company chooses not to commit the infringement, the crew chooses not to report it, and the government authority chooses not to investigate the evidence. At this time, the three parties' payments are: 0, 0 and 0 respectively.

### 3.2. Solving the equilibrium solution of the model

Model 1: Under the assumption that the probability of a shipping firm committing an infringing act is  $P_1$  the premise. The expected benefits of crew reporting are

$$R_1 = P_1\{P_3(D - C_2) + (1 - P_3)[-(1 - a)bM - C_2]\} + (1 - P_1)[P_3(-C_2) + (1 - P_3)(-C_2)]$$

while the expected benefit for non-reporting is  $R_2 = P_1[-(1 - a)bM - C_2]$  When there is no difference between the expected benefits of crew members reporting and not reporting, i.e.  $R_1 = R_2$  then the optimal probability of a crew member committing an infringement by a shipping firm at the game equilibrium is obtained as

$$P_1 = \frac{C_2}{P_3[D + (1 - a)bM]}$$

Model 2: Given that the probability of a shipping company committing an infringement is  $P_1$ , the expected benefit of a government authority's investigation is:

$$R_3 = P_1[P_3(F + E - C_3) + (1 - P_3)(-E - C_3)] + (1 - P_1)[P_3(-C_3) + (1 - P_3)(-C_3)]$$

And the expected return without checking is:  $R_4 = P_1(-E)$ . When there is no difference in the expected gain between the government authority to investigate and not to investigate, i.e.  $R_3 = R_4$  then the optimal probability that the government authority commits the infringement by the firm in the game equilibrium is obtained as

$$P_1 = \frac{C_3}{P_3(F + 2E)}$$

Model 3: Given the probability of investigation by crew

members and government authorities (reporting)  $P_2$  the expected benefits of the shipping firm's choice of aggression, given that

$$R_5 = P_2\{P_3(-D - F - C_1) + (1 - P_3)[(1 - a)bM - C_1]\} + (1 - P_2)(1 - a)bM - C_1$$

and the expected gain without infringement is  $R_6 = 0$ . When there is no difference between the shipping enterprises' choice of infringement and non-aggression expected gain, i.e.  $R_5 = R_6$  when, the optimal probability of shipping enterprises in the game equilibrium, crew and government authorities (reporting) to check the evidence is obtained as

$$P_2 = \frac{(1 - a)bM - C_1}{P_3[D + (1 - a)bM]}$$

Thus, the mixed strategy Nash equilibrium of the game model constructed in this paper is:

$$P_1^* = \frac{C_2}{P_3[D + (1 - a)bM]} \quad (1)$$

$$P_2^* = \frac{(1 - a)bM - C_1}{P_3[D + F + (1 - a)bM]} \quad (2)$$

or

$$P_1^* = \frac{C_3}{P_3(F + 2E)} \quad (3)$$

$$P_2^* = \frac{(1 - a)bM - C_1}{P_3[D + F + (1 - a)bM]} \quad (4)$$

The Nash equilibrium of model 1 indicates that if the whistleblowing behavior of crew members is the focus of the examination, the optimal probability of shipping firms will choose to commit aggression with the expression ①. If the shipping firm chooses to commit the aggression with probability  $P_1 > P_1^*$  If the shipping firm chooses to commit the violation with probability, then the optimal choice of the crew member is to report the violation; conversely, the crew member does not report the violation. If the shipping company chooses with probability  $P_1 = P_1^*$  If the shipping company chooses to commit the violation with probability, then the optimal choice for the crew is to report or not to report at random. In the expression (1) of the optimal probability that a shipping company chooses to commit an act of aggression  $P_1^*$  In the expression (1) of the shipping enterprise, it is assumed that the amount of aggression of the shipping enterprise  $(1 - a)bM$  is established, which is a factor that is difficult to change through subjective efforts. Thus, what can be changed through efforts are  $C_2$ ,  $DP_3$ ,  $D$  these three variables, obviously  $P_1^*$  is proportional to the reporting cost of crew members  $C_2$  and the probability of successful investigation by government authorities  $P_3$  Therefore, the focus of reducing the probability of shipping companies to commit violations is to reduce the cost of reporting by laborers and to increase the probability of successful detection by government authorities.  $C_2$  and increase the probability of successful detection by government authorities  $P_3$  and increase the amount of compensation  $D$ .

The Nash equilibrium of model 2 indicates that if the investigation behavior of government authorities is the focus of the investigation, shipping companies will choose to commit infringement with optimal probability ③. If shipping

companies choose to commit infringement with probability  $P_1 > P_1^*$ . If the shipping enterprise chooses to commit the infringement, then the optimal choice of the government authority is to investigate the evidence, and vice versa. If the shipping enterprise chooses to commit the infringement with probability  $P_1 = P_1^*$ . If shipping enterprises choose to commit infringement with probability, then the optimal choice of government authorities is to report or not to report randomly. In the expression (2) of the optimal probability of shipping enterprises to choose the infringement  $P_1^*$  in the expression (2), the  $P_1^*$  is proportional to the cost of investigation  $C_3$  is proportional to the cost of investigation, and is inversely proportional to the probability of successful investigation.  $P_3$ . Therefore, the focus of reducing the probability of committing infringement is to reduce the cost of investigation by government authorities and increase the probability of success of investigation by government authorities.  $C_2$ . The main points of reducing the probability of infringement by enterprises are: reducing the cost of investigation by government authorities, increasing the probability of successful investigation by government authorities  $P_3$ . Therefore, the focus of reducing the probability of infringement by enterprises is to reduce the cost of investigation by government authorities, to increase the fines  $F$  of shipping enterprises, and to increase the positive utility  $E$  of government authorities.

The Nash equilibrium of model 3 indicates that crew members and government authorities will choose (report) to check the evidence with optimal probability (4). If labor and government authorities choose  $P_2 > P_2^*$  the optimal side strategy of the shipping firm is not to infringe; conversely, it is to choose to infringe; if the crew and government authorities choose to (report) check with probability  $P_2 = P_2^*$  (whistleblowing), then the optimal choice of the shipping company is to randomly choose to infringe or not to infringe. In the optimal probability of crew members and government authorities (reporting) to investigate and deal with  $P_2^*$ . In the expression, it is assumed that the amount of enterprise infringement  $(1-a)bM$  is a given factor that is difficult to change through subjective efforts. The variables that can thus be changed through effort are  $C_2$ ,  $D$  and  $E$ . These three variables, obviously  $P_2^*$ . The same as the cost of infringement  $C_1$ . Therefore, the focus of increasing the probability of crew members and government authorities (reporting) to investigate the behavior is to: increase the cost of corporate infringement  $C_1$ . From the above analysis of the Nash equilibrium solution, it is assumed that the amount of corporate aggression  $(1-a)bM$ . In the above Nash equilibrium solution, it is assumed that the amount of corporate aggression is fixed, but in fact, the change of this constraint itself will also have an impact on the aggression of shipping companies. When  $(1-a)bM$  increases, the optimal probability by the optimal  $P_1^*$  expression leads to  $P_1$  decreases. Our interpretation is that the larger the amount of infringement by shipping enterprises, the higher the probability of crew members and government authorities (reporting) to investigate, the higher the possibility of shipping enterprises' infringement being investigated and punished, thus shipping enterprises dare not infringe on crew members' interests instead. Further, we can get the relationship between  $MP_1^*$  is inversely proportional to  $M$ , that is, increasing the total wealth of the enterprise can reduce the probability of infringement by the enterprise.  $P_1$ . The

probability of the infringement is reduced by increasing the total wealth of the firm.

## 4. Recommendations

Firstly, we should further improve the relevant legal system, increase the compensation amount of shipping enterprises  $D$ . Especially, we should speed up the introduction of supporting labor security supervision procedure law, form a systematic and perfect labor security law and regulation system, so that it can become the legal basis and standard of grassroots labor supervision, better regulate the labor employment management of shipping enterprises, help crew members to protect their legal rights, and ensure the labor supervision work of crew members. There are laws to follow and laws to follow (Liang, 2021).

Secondly, the construction of labor inspection team should be further strengthened to reduce the investigation cost of labor inspection department. The life of the system lies in the implementation and the ultimate ability to take root. In order to truly improve the labor inspection mechanism of crew members, the inevitable problem that needs to be solved is to further strengthen the construction of labor inspection teams (Leng, 2021). Therefore, the personnel and working expenses of the labor inspection team should be appropriately increased to ensure the quality of handling cases.

Third, the competent government departments should further strengthen the guidance and management of the employment of crews of employers, strictly in accordance with the law, and should increase the penalties, increase the fines  $F$  for enterprises, and increase the costs that enterprises need to pay for implementing infringing acts  $C_1$ .

Fourth, the government authorities should continue to accumulate regulatory experience and adopt advanced technical means, with a view to reducing the cost of investigation  $C_2$ .

Fifth, the government authorities in the investigation and handling of dereliction of duty should be seriously punished, while giving the necessary material rewards and moral support to those who conscientiously perform the duties of supervision and investigation to improve the level of utility  $E$ , with a view to improving the success rate of government authorities in the investigation and handling of evidence.  $P_3$ . The government authorities should also be given the necessary material rewards and moral support to those who earnestly perform their supervisory and investigative duties.

Sixthly, collective negotiation and collective dispute resolution mechanism should be improved, and interest disputes should be further incorporated into the existing administrative and judicial assistance system to reduce the burden of labor inspection departments from the source (Yang, 2020). Thus, it can fully protect the labor interests of crew members without overly damaging the economic benefits of shipping enterprises.

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