

# Research on Long-term Incentive Effect of Local Government Environmental Protection

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**Abstract:** With the development of our country's economy, the government has paid more attention to environmental protection and invested a lot of resources, but the ecological environment has not been significantly improved. The article believes that the main reason is that the local government's environmental protection activities have not received enough incentives. Taking this as a starting point, the article designed an incentive model to enhance the environmental protection efforts of local governments, prompting local governments to consider long-term environmental conditions.

**Keywords:** Long-term incentives; environmental protection; reputation mechanism; environmental supervision

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## INTRODUCTION

With the rapid development of China's economy, the problem of environmental pollution has become increasingly prominent. The current environmental conditions have a considerable correlation with the current institutional arrangements, and the administrative directives, supervision and management of the regulatory system are far away. Far from adapting to the needs of the new situation, the existing economic incentive system needs to be reformed, and the economic incentive system under the conditions of the market economy needs to be urgently innovated in order to promote the healthy development of China's environmental protection cause and achieve economic, social, resource, environmental, and ecological sustainability development.

In China, the bad behavior of local governments for sacrificing the environment for short-term performance is not optimistic. This has hindered the healthy development of the local economy to a large extent, and it is directly damaging the interests of the country and the people. Therefore, how to effectively stimulate the local government to achieve the consideration of environmental protection under economic growth is a content worthy of study and it is of great significance. The incentives involved in the article include local government reputation incentives (that is, protecting the environment will bring good environmental protection reputation to the local government), performance incentives (that is, to achieve the corresponding return under the central government's established environmental protection indicators), after leaving office incentives (if the performance of the local government exceeds a fixed value after the agent leaves office, the agent can obtain local government performance due in part to previous environmental protection measures) to

stimulate the local government to consider long-term environmental protection issues.

Since the 1980s, the principal-agent theory has been gradually introduced into the protection of environmental resources. Under the framework of principal-agent theory, the central government is the principal and the local government is the agent. Because of the existence of information asymmetry, designing a reasonable and effective incentive contract is very important.

The concept of reputation incentives was first proposed by Fama(1980). He pointed out that in the context of a sound market economy system, managers are usually trying to achieve a good reputation effect. Even if the company's long-term performance is linked to managers rewards, they will work hard. The effort to improve current performance and prepare for long-term performance improvement shows that implicit incentives, such as reputation, can replace explicit incentives to some extent. Holmstrom and Meyer and others (Holmstrom(1997), Meyer(1997)) believe that manager's reputation consideration is a hidden incentive for managers. This incentive can replace managerial compensation incentives to a certain extent, or even if the manager compensation is not shared with the company. Performance is linked and managers will work hard. Holmstrom's later research shows that as managers aged, the effect of reputation incentives diminishes. In short, the incentive role of the reputation mechanism is universally recognized.

The behavior of local governments in China is greatly affected by the performance evaluation and fiscal system. Performance assessment is based on GDP, and the development of local economy will bring economic incentives to local governments (Yingyi(1996), Yang Ruilong(2002), Pi Jiancai(2012), Xie Zhenfa(2015)). This once played an important role in China's economic growth, but it also led to local government officials gradually deviating from

the public The track of interests has caused local governments to lack the incentive to provide ecological products. The fiscal and taxation system in China is a tax-sharing system. Representatives of the new fiscal decentralization theory believe that if there is no effective incentive and constraint mechanism, local government officials have the same opportunistic behavior as corporate managers, and they may all seek rent from political decisions. In this way, the value targets of local governments in our country and the value objectives of the central government may be inconsistent or even opposite in the short term. Therefore, analyzing the behavior choices of local governments not only has theoretical significance but also has theoretical significance for the implementation of environmental protection policies and the consolidation of achievements in China.

However, long-term incentives for operators based solely on reputation incentives are far from enough. Incentives combined with performance incentives and post-departure incentives can play a greater role. The article constructs an incentive model for the central government and local governments, providing ideas for regulating the behavior of local governments and enterprises, and improving their environmental protection efforts, with a view to long-term development of the environment.

### MODEL BASIC ASSUMPTIONS AND SOLUTION ANALYSIS

The output function model of the local government can be expressed as:

$$\pi_t = a_t + ha_l + \theta_1 \quad (0 < h < 1)$$

$$\pi_l = \pi_t + fa_l + \theta_2 \quad (0 < f < 1)$$

In the above formula,  $\pi_t$  is a short-term achievement that does not attach importance to environmental protection, and  $\pi_l$  is a long-term performance that focuses on environmental protection. Here, short-term is defined as the term of a local government official and is defined as a term outside the term.  $a_t$  denotes the agent's normal management effort level,  $a_l$  denotes the agent's long-term effort to consider environmental protection,

denotes the conversion factor for environmental protection efforts for short-term government performance, and  $f$  denotes the conversion factor for environmental performance efforts for long-term performance.  $\theta_1$  and  $\theta_2$  are normal random variables with a mean of 0 and variances of  $\sigma_1^2$  and  $\sigma_2^2$ , which indicate the uncertainties in the current and long-term corporate performance.

According to the research on the reputation mechanism, the environmental protection reputation owned by the agent can be monetized and discounted as:

$$R_m = f(\pi) = \mu(\pi_t - \pi_0)$$

Among them,  $\mu$  is the reputational utility coefficient, that is, the degree of local government's

esteem for environmental reputation, and  $\pi_0$  is the minimum level set by the client. Here, assuming that the market risk is small, it is ignored.

The cost of a manager's effort is the form of a marginal increasing function, generally set as:  $C(a_i) = \frac{1}{2}b_i a_i^2$ , where  $b_i$  is the effort cost factor. The paper assumes that the various efforts made by the managers are not related to each other, then the manager's hard cost function model can be obtained as follows:

$$C(a) = \frac{1}{2}b_t a_t^2 + \frac{1}{2}b_l a_l^2$$

The incentive mechanism provided to the agent is divided into three parts, namely, the agent's fixed income, performance incentive income, and incentive income after leaving office. The contract can be expressed as:

$$S = \alpha + \beta (\pi_t - \pi_m) + \omega \max (\pi_l - \pi_e, 0)$$

Among them,  $\alpha$  represents fixed income,  $\beta$  represents the environmental protection incentive coefficient,  $\pi_m$  represents the minimum performance set by the client,  $\omega$  represents the incentive coefficient after departure, and  $\pi_e$  represents the predetermined long-term performance value of the client.

According to the general provisions of information economics(Zhang weiyang(1996)), the principal's attitude toward risk is neutral, the manager is risk averse, and the manager's certainty equivalent income CE can be expressed as:

$$CE = \alpha + \beta (\pi_t - \pi_m) + \omega \max (\pi_l - \pi_e, 0) + \mu(\pi_t - \pi_0) - \frac{1}{2}b_t a_t^2 - \frac{1}{2}b_l a_l^2 - \frac{1}{2}\rho\beta^2\sigma^2 - \frac{1}{2}\rho\omega^2\sigma^2$$

Managers choose the optimal level of effort to maximize their deterministic equivalent income:

$$\frac{\partial(CE)}{\partial a_t} = \beta + \omega + \mu - a_t b_t = 0$$

$$\frac{\partial(CE)}{\partial a_l} = \beta h + \omega(h + f) + \mu h - a_l b_l = 0$$

$$\text{s.t. } a_i \geq 0$$

The above three equations are solved together to obtain the manager's optimal behavior combination:

$$A^* = \{a_t^*, a_l^*\} = \left\{ \frac{\beta + \omega + \mu}{b_t}, \frac{h(\beta + \omega + \mu) + f\omega}{b_l} \right\}$$

From the above-mentioned optimal level of effort, it can be seen that the local government's current best effort increases with the increase of  $\beta, \omega, \mu$ , and decreases with the increase of the current

effort cost coefficient  $b_t$ . This is because if the principal gives the agent a higher incentive coefficient, the agent will certainly pay a higher level of effort to make himself more effective, and if the agent's cost coefficient increases, it means that the agent's effective efforts. When the conversion rate is low, the agent is not willing to pay a high level of effort. At the same time, when considering environmental protection reputation, agents will pay more attention to the environmental protection reputation, and they will pay higher levels of hard work. On the one hand, it comes from the desire of the central government to recognize their own environmental performance, and on the other hand, it is due to the expectation of economic compensation. The impact factors of the long-term optimal efforts are more than the current optimal factors. There are two factors,  $\alpha$  and  $f$ . It can be clearly seen that these two impact factors have positive effects on the long-term optimal efforts. The economic implications are that if the agents The long-term environmental protection behavior will increase the positive return of the current period performance, and the long-term behavior of agents will have a greater effect on long-term performance. Agents will pay more excellent long-term efforts based on rational considerations. This is also the result of popular interest. The growth of performance, but also taking into account environmental protection, is a virtuous circle.

The principal then formulates the appropriate environmental incentive factor  $\beta$  and the after-service incentive coefficient  $\omega, \tilde{\omega}$  according to the agent's best effort level to maximize the effectiveness of the agent's expected minimum compensation level:

$$\begin{aligned} & \max E(v) = E(\pi_l - S) \\ \text{s. t. (IR)} & \alpha + \beta (\pi_t - \pi_m) + \omega \max (\pi_l \\ & - \pi_e, 0) + \mu(\pi_t - \pi_0) - \frac{1}{2} b_t a_t^2 \\ & - \frac{1}{2} b_s a_s^2 - \frac{1}{2} b_l a_l^2 - \frac{1}{2} \rho \beta^2 \sigma^2 \\ & - \frac{1}{2} \rho \omega^2 \sigma^2 \geq \tilde{\omega} \end{aligned}$$

(IC)

$$\begin{aligned} a_t^* &= \frac{\beta + \omega + \mu}{b_t} \\ a_l^* &= \frac{h(\beta + \omega + \mu) + f\omega}{b_l} \\ 0 &< \beta < 1; 0 < \omega < 1 \\ \beta^* &= \frac{(1 - \omega)[b_l + b_t(h^2 + fh)]}{b_l + h^2 b_t + b_t b_l \rho \sigma^2} \\ \omega^* &= \frac{b_l(1 - \beta) + b_t[(f + h)^2 - h^2 \beta - fh\beta]}{b_l + b_t(h^2 + f^2) + b_s b_l + b_t b_l \rho \sigma^2} \end{aligned}$$

From the above formula, we can see that the optimal environmental protection incentive coefficient  $\beta^*$  and the optimal exiting incentive

coefficient  $\omega^*$  are constrained by many factors. Next, we will analyze them one by one.

## RESULTS AND DISCUSSIONS

### Analysis of Factors Affecting the Optimal Environmental Protection Incentive Coefficient

#### $\beta^*$

The relationship between exclusion factor after departure  $\omega$  and  $\beta^*$ . It can be obtained  $\frac{\partial \beta^*}{\partial \omega} = -\frac{b_l + (h^2 + fh)}{b_l + h^2 b_t + b_t b_l \rho \sigma^2}$ , that is  $\frac{\partial \beta^*}{\partial \omega} < 0$  is established.  $\beta^*$  and  $\omega$  are negatively related, and as the  $\omega$  increases(decreases),  $\beta^*$  decreases(increases). When the client gives incentives for a relatively high exit, the client will tend to give a relatively low optimal environmental incentive factor after balancing the costs.

The relationship between short-term effort factor  $b_t$  and long-term effort factor  $b_l$  and  $\beta^*$ .

$$\begin{aligned} \frac{\partial \beta^*}{\partial b_l} &= -\frac{(1 - w)(f h b_t + h^2 b_t^2 \rho \sigma^2 + f h b_t^2 \rho \sigma^2)}{(b_l + h^2 b_t + b_t b_l \rho \sigma^2)^2} \\ \frac{\partial \beta^*}{\partial b_t} &= \frac{b_l(1 - w)(f h - b_l \rho \sigma^2)}{(b_l + h^2 b_t + b_t b_l \rho \sigma^2)^2} \end{aligned}$$

It can be clearly seen that  $\frac{\partial \beta^*}{\partial b_l} < 0$  is constant, and when the long-term effort cost factor increases, it will reduce the manager's effort level, and If the local government's environmental efficiency is low, or there is no long-term consideration for environmental protection, it will not be recognized by the central government and there will be no need to give too high an incentive coefficient. This is mainly due to the low internal administrative efficiency and long-term incentives. Nor can we counterbalance institutional flaws.

When  $f h > b_l \rho \sigma^2$ ,  $\frac{\partial \beta^*}{\partial b_t} > 0$ , It shows that the optimal environmental protection incentive coefficient increases with the increase of the short-term effort cost coefficient, and decreases. When  $f h < b_l \rho \sigma^2$ ,  $\frac{\partial \beta^*}{\partial b_t} < 0$ , it means that the increase of the short-term cost coefficient will cause the reduction of  $\beta^*$ . The product of the long-term effort conversion factor for short-term performance  $h$  and the long-term performance conversion factor  $f$  for long-term performance represents the total contribution to long-term performance. When it is greater than the product of market risk fluctuation and long-term cost coefficient, it indicates that the agent has long-term performance. The output is sufficient to resist the consumption of long-term effort costs and market risks. The greater the short-term effort cost, the stronger this resistance will prompt the client to give a higher optimal reward, and vice versa.

The relationship between conversion factors  $f, h$  and  $\beta^*$ . In order to simplify the calculation, suppose  $b_t = b_l = b$ .

$$\beta^* = \frac{(1 - \omega)[1 + (h^2 + fh)]}{1 + h^2 + b\rho\sigma^2}$$

$$\frac{\partial\beta^*}{\partial h} = \frac{(1 - \omega)(2hb\rho\sigma^2 + 3fh^2 + f + fb\rho\sigma^2)}{(1 + h^2 + b\rho\sigma^2)^2}$$

$$\frac{\partial\beta^*}{\partial f} = \frac{h(1 - \omega)}{1 + h^2 + b\rho\sigma^2}$$

Based on the above results, the conversion factor  $f, h$  is a positive effect  $\beta^*$ . When the manager's efforts can be reflected to the greatest extent, it will stimulate the improvement of performance. When the environmental protection efforts of the local government can be reflected to the greatest extent, it will stimulate the improvement of government performance. When the trustee observes an ever-increasing performance, in order to continuously improve performance, there will be incentives to give agents higher optimal performance incentives. Level, on the contrary, will reduce the optimal performance incentive coefficient.

**Analysis of factors affecting the after the best departure from the incentive coefficient  $\omega^*$ .**

$$\omega^* = \frac{b_l(1 - \beta) + b_t[(f + h)^2 - h^2\beta - fh\beta]}{b_l + b_t(h^2 + f^2) + b_s b_l + b_t b_l \rho\sigma^2}$$

$$\frac{\partial\omega^*}{\partial\beta} = \frac{-b_l - b_t(h^2 + fh)}{b_l + b_t(h^2 + f^2) + b_s b_l + b_t b_l \rho\sigma^2}$$

It can be seen from the above equation that  $\beta$  is negatively correlated with  $\omega^*$ . This is consistent with the effect of  $w$  on  $\beta^*$  in the previous article. The national finance is limited, so the central government also considers paying the cost, so the changes in these two coefficients are shifting, which is conducive to the rational allocation of the central government's finances.

Next, we use the control variable method and the valuation method, that is, when analyzing a factor, assuming that other factors remain constant at a constant, to analyze the impact of different factors on the optimal stock incentive. Assume that the basic assignments are:  $b_t = b_l = b = 0.5$ ,  $f = h = 0.5$ ,  $\rho\sigma^2 = 3$ ,  $\beta = 0.1$ . The analysis data is shown in Figure 1-4.

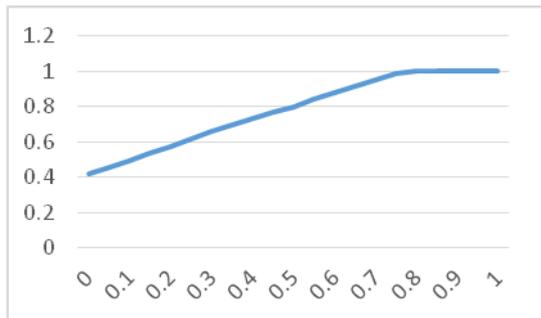


Figure 1 The effect of increasing  $h$  on  $\omega^*$

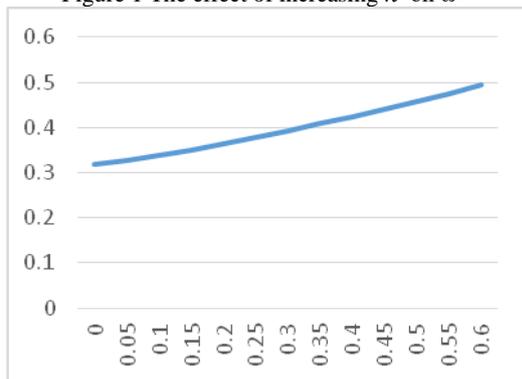


Figure 2 The effect of increasing  $f$  on  $\omega^*$

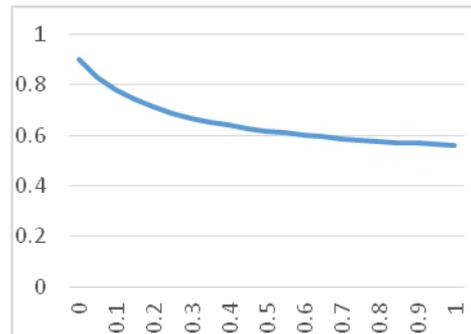


Figure 3 The effect of increasing  $b_t$  on  $\omega^*$

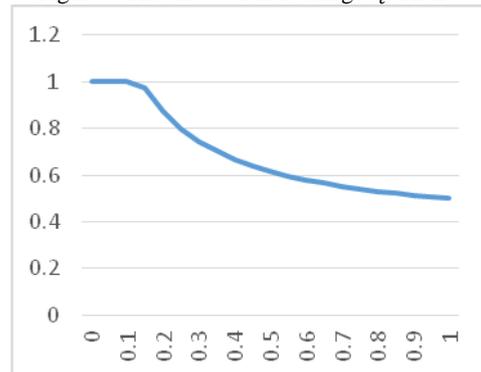


Figure 4 The effect of increasing  $b_l$  on  $\omega^*$

The influence of various coefficients on the optimal stock incentive coefficient  $\omega^*$  sum and the influence on  $\beta^*$  are similar. From Figure 1 to Figure 4 it can be clearly seen that represents the short-term long-term conversion factor performance and long-term long-term efforts The conversion factor  $f$  of performance is positively related to  $\omega^*$ , that is, with the follow-up The value of  $\omega^*$  is smaller as the value of  $b_i$  increases as the value increases

with time. It is not difficult to understand that when the local government's environmental protection efforts and normal efforts can be more efficiently translated into observable government performance, and the local government's environmental protection efforts are less costly, it shows that the local government has sufficient capacity to be able to achieve central government With regard to the government's requirements for environmental protection, the central government will tend to

increase the awareness of environmental protection and will tend to give higher incentives to encourage local governments to pay more attention to the protection of the environment instead of simply pursuing GDP growth and achieving sustainable development.

### CONCLUSIONS

At present, many local governments have sacrificed the environment for short-term performance output, resulting in long-term development without guarantees, even at the expense of long-term interests in exchange for short-term performance. One of the important reasons is that there is no effective long-term environmental protection for the local government. Incentive mechanism, the article designed an incentive mechanism that combines the performance sharing system and the post-departure incentive system, in order to analyze the relative efforts of the agent and the changing trend of the optimal incentive coefficient. Through analysis, the following conclusions can be drawn.

First, the relationship between the optimal environmental protection incentive coefficient and the optimal post-appointment incentive coefficient is opposite. This is mainly because the client considers the result of the employment cost.

Second, the agent's short-term optimal effort level and long-term optimal effort level are negatively constrained by the effort cost factor, which is proportional to the incentive coefficient and the contribution conversion factor. The conversion factor means the effective output of the agent. The greater the conversion factor, the more obvious the output level, and the agent will be more willing to pay a high level of effort. The existence of the incentive factor is in order to increase the agent's efforts. If the environmental protection measures taken by the local government can be effective as soon as possible, it means that the policies formulated by the local government are effective and can achieve certain results. Therefore, the central government should give high incentives to reinforce this environmental protection behavior.

Third, generally, the optimal incentive coefficient increases with the increase of the conversion coefficient, decreases and decreases, that is, it has a positive correlation and negative correlation with the effort cost coefficient. When the long-term environmental protection efforts made by the local government can be reflected to the greatest extent, it will stimulate the improvement of performance. When the trustee observes the long-term improvement of the government's long-term performance, it will have a higher motivation to give the agent higher performance for continuous improvement. The optimal environmental protection incentive level, on the contrary, will

reduce the optimal environmental protection incentive factor.

China's performance evaluation system with short-term GDP at the current stage is a kind of operation that ignores the importance of environmental protection. It only pays attention to the economic development situation. The increase in GDP is used as an indicator to measure the level of social welfare. It cannot fully reflect the current and future contents of social welfare, resulting in local government's choice of behavior deviating from the maximization of social benefits, resulting in the abuse of natural resources and the ecology. Damage to the environment. Therefore, only when the indicators of ecological environment protection, use of natural resources, and indicators of environmental destruction are included in the performance evaluation system can the local government balance the ecological protection and economic growth, and enhance the enthusiasm of local governments for environmental protection.

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