

# Incentives Research for Enterprises to Participate in VEP in the Multitask Principal-Agent Model

Sha Mo and Xiaoping Shi

Hunan University, 410082 Changsha Hunan, China

**Abstract.** As a comprehensive environmental management system with a higher statutory environmental standard, Voluntary Environmental Program has become a trend of international environmental policy and the essence of it is a multi-agency task, in which government (principal) entrust enterprise (proxy) develop economic in the context of protecting the environment. Moreover, government is in a dominant position in the effective implementation of voluntary environmental program, and their incentive to set different targets, under the voluntary environmental program, play a key role for the effective implementation of voluntary environmental program.

**Keywords.** Voluntary Environmental Program; enterprise; Multitask Principal-Agent Model

## 1 Introduction

### 1.1 The Background and philosophy of Voluntary Environmental Program

Voluntary Environment Program is referred as VEP. As one form of voluntary environmental management measures, voluntary environment program is also known as VEA (Voluntary Environment Agreement). As a methods or policies tool, Voluntary Environmental Program is establishing the mutual restraint between governments and the enterprises, enterprises and enterprises, and enterprises and other organizations in a voluntary agreement, to promote the business or industry to improve their environmental management practices, the environmental quality or efficiency of resource<sup>[1]</sup>. (Patriekten Brink, 2002). VEP is occurred as an alternative means to improve the quality of the environment in the 1980s, and has rapidly developed in OECD countries, the United States, and other countries in the 1990s. When compared with traditional environmental management practices, the main feature of VEP is its higher statutory environmental standards and voluntary participation.

### 1.2 Put forward the issue

Essentially voluntary environmental program is a no mandatory binding agreement, and enterprises decide whether to join the agreement or not voluntarily (Jordan A, 2003). Voluntary environmental agreements don't have the force of law to constraint the participants to reduce pollution emissions (Borkey P., Glachant M. & Leveque F., 1998).

There is a cost of the implementation of efforts to protect the ecological environment, such as energy conservation for enterprises. However, enterprises is a profit-maximizing economic man, so we need the governments to provide some form of incentive to support the contracting business or industry commitment to achieve the environmental goals within a certain period. Therefore, research the incentives of enterprises to participate in voluntary environmental program from the perspective of the agency, has important practical significance.

## 2 The VEP running analytic framework based on multitasking agent

There exists a similar agency relationship between the government and enterprises in a voluntary environmental program, in which the government (principal) commis enterprise (proxy) to take measures to protect the ecological environment, such as energy saving in the production process.

### 2.1 Agents of the voluntary environmental program

**(1) Government:** Government, as the main responsibility for providing public goods, in line with the harmonious development of man and nature, has increasingly emphasis on prevention of ecological environment, and it naturally becomes the principal of the voluntary environmental program. Meanwhile, the poor management in rent-seeking and oversight, light legal sanctions for environmental violations, also make the government's principal

role controversially. The ideas of the party's 18 Third Plenary Session of the Central Committee, "CPC Central Committee on deepening reform and comprehensive reform of a number of major issues," on voluntary environment program, makes the government principal role in the voluntary environment program more solid and reliable.

(2) **Enterprise:** As the proxy of the voluntary environment program, they will not take the initiative measures to protect the ecological environment (although they are also the direct victims when the ecological environment is destroyed), because their goal is to create maximizing revenue in the short term.

## 2.2 Agency goals of VEP

Multitask agency relationship is a contractual relationship. According to contract that government and enterprises specified, the government hire enterprises to make efforts to protect the ecological environment and then, government will pay appropriate compensation based on enterprises conduct or outcome, in a multitask agency relationship of voluntary environmental program.

Ecological and environmental the first course protection in Voluntary environmental program, but we must take into account that many of the high energy consumption industries plays a crucial role in safeguarding people's livelihood. Therefore, the voluntary environmental program needs to coordinate the delicate relationship among the environmental protection and economic development and the people's livelihood. To facilitate the study, according to government and corporate parties specified in the contract. To facilitate the study, this article will set the multiple objectives of the voluntary environmental program into two categories, one is the goal of the ecological environment, and the second is the economic development goals.

## 3 To build the model of multi-task agency relationship in VEP

Government (principal) guides the enterprise (proxy) to complete the two objectives, which are in accordance with the government (principal) benefit requirements, by giving enterprise (proxy) a certain incentive, since the government (principal) can not observe the enterprise (proxy) compliance behavior in a zero-cost way, so the government (principal) will need to design an effective incentive mechanism to achieve self-enforcing contract and to motivate the enterprise (proxy) to maximum complete the agency goal. So, at first we should build the agency function of costs and benefits of enterprise (proxy) and government (principal) who participate involuntary environmental program. And through optimizing the expected income of the government and enterprises to solve Pareto optimal.

Suppose, enterprise (proxy) participate in voluntary environmental program, namely, enterprise (proxy) accepts the government (principal) delegates and achieves the two goals of economic development and protecting the environment, then, their reward is their output income, while assuming business. Meanwhile, suppose the horizontal vector of enterprise's (proxy) effort in voluntary environmental program is  $a=(a^1, a^2)$ ,  $a^1$  and  $a^2$  represent the enterprise level of effort in ensuring revenue growth and protecting the ecological environment, and both of them can be measured in monetary terms.  $c(a^1, a^2)$  is the effort cost of enterprise to participate in voluntary environmental program and it is a strictly increasing convex function, and let:

$$c(a_1, a_2) = \frac{c_{11}}{2} a_1^2 + \frac{c_{22}}{2} a_2^2 + c_{12} a_1 a_2 \quad (1)$$

$c^{11}$ ,  $c^{12}$ ,  $c^{22}$  are constants that greater than zero. In addition, the overall efficiency (is available to be measured by money, and a strictly increasing concave function) that enterprise (proxy) created by participating in voluntary environmental program is  $\pi$ :

$$\begin{aligned} \pi &= \pi_1 + \pi_2 \\ \pi_1 &= a_1 + \varepsilon_1 \\ \pi_2 &= a_2 + \varepsilon_2 \end{aligned} \quad (2)$$

Among them,  $\varepsilon = (\varepsilon_1 \text{ and } \varepsilon_2)$  is a random variables that obeys normal distribution, its mean is 0, covariance matrix is  $\Sigma = \begin{pmatrix} \sigma_1^2 & 0 \\ 0 & \sigma_2^2 \end{pmatrix}$ ,  $\sigma_1^2$  and  $\sigma_2^2$  are the variance of

$\varepsilon_1$  and  $\varepsilon_2$ ,  $\varepsilon_1$  and  $\varepsilon_2$  are the uncertainties and risks of enterprise (proxy) pays to achieve the goals in voluntary environmental program, which can represent the risk that enterprise (proxy) commits while ensuring the benefits of economic and ecological in the voluntary environmental program. In the Formula (2), when the effort level are  $a_1$  and  $a_2$  the corresponding benefit of them are  $\pi_1$  and  $\pi_2$ .

Suppose, the risk of government is neutral, and the risk of the enterprise (proxy) is averse,  $s(\pi_1, \pi_2)$  is compensation payment function then:

$$s(\pi_1, \pi_2) = \alpha + \beta_1 \pi_1 + \beta_2 \pi_2 \quad (3)$$

$\beta^T = (\beta_1, \beta_2)$  is the excitation intensity vector,  $0 \leq \beta_i \leq 1$  (i-1).

The expected utility of the government is:

$$E v = E \pi - E s(\pi_1, \pi_2) = a_1 + a_2 - \alpha - \beta_1 a_1 - \beta_2 a_2 \quad (4)$$

Actual income and expect income of enterprise were:

$$\omega = s(\pi_1, \pi_2) - c(a_1, a_2) = \alpha + \beta_1 \pi_1 + \beta_2 \pi_2 - \frac{c_{11}}{2} a_1^2 - \frac{c_{22}}{2} a_2^2 - c_{12} a_1 a_2 \quad (5)$$

$$E \omega = E [s(\pi_1, \pi_2) - c(a_1, a_2)] = \alpha + \beta_1 a_1 + \beta_2 a_2 - \frac{c_{11}}{2} a_1^2 - \frac{c_{22}}{2} a_2^2 - c_{12} a_1 a_2 \quad (6)$$

Suppose  $u$  is the business utility function, and it has a constant absolute risk aversion characteristics, then  $u = e^{-\rho\omega}$ ,  $\rho$  is the absolute measure of risk aversion,  $\omega$

$$CE = E\omega - \frac{1}{2}\rho Var(\omega) = \alpha + \beta_1 a_1 + \beta_2 a_2 - \frac{c_{11}}{2} a_1^2 - \frac{c_{22}}{2} a_2^2 - c_{12} a_1 a_2 - \frac{1}{2}\rho\beta_1^2 - \frac{1}{2}\rho\beta_2^2 \quad (7)$$

$E\omega$  is the expect income of the enterprise,  $\frac{1}{2}\rho Var(\omega)$  is the cost of risk of the enterprise.

In order to solve the agency's problem of asymmetric information between government and business in the VEP, two conditions must be met: the incentive constraints and the participating constraints.

$$(IC) \max_{(a_1, a_2)} CE = \max_{(a_1, a_2)} \alpha + \beta_1 a_1 + \beta_2 a_2 - \frac{c_{11}}{2} a_1^2 - \frac{c_{22}}{2} a_2^2 - c_{12} a_1 a_2 - \frac{1}{2}\rho\beta_1^2 - \frac{1}{2}\rho\beta_2^2 \quad (8)$$

When consider the participating constraints, it requires the certainty equivalent income enterprise (proxy) achieved by receiving the incentive contracts of govern-

$$(IR) CE = \alpha + \beta_1 a_1 + \beta_2 a_2 - \frac{c_{11}}{2} a_1^2 - \frac{c_{22}}{2} a_2^2 - c_{12} a_1 a_2 - \frac{1}{2}\rho\beta_1^2 - \frac{1}{2}\rho\beta_2^2 \geq \bar{\omega} \quad (9)$$

### 4 Conclusions and policy implications

Suppose  $\sigma_2 \rightarrow +\infty$  examine the limits of  $\beta_2$ , we can obtain:

$$\lim_{\sigma_2^2 \rightarrow +\infty} \beta_1 = \frac{1 - \frac{c_{12}}{c_{22}}}{1 + \rho\sigma_1^2(c_{11} - \frac{c_{12}^2}{c_{22}})} \quad (10)$$

$$\lim_{\sigma_2^2 \rightarrow +\infty} \beta_2 = 0 \quad (11)$$

As can be seen from the equation (10), to achieve the goals of economic incentives for enterprise, government should base on the cost of corporate efforts to determine the incentive payment.

Secondly, according to formula (11), to achieve the goals of incentives for enterprise in protecting the ecological environment, government should take a fixed or providing financial subsidy to pro-environmental certification and other measures.

Again, in the process of achieving two goals of voluntary environmental program, if the cost of the enterprises in their efforts to achieve economic goals and objectives of of the environment are mutually independent, we can obtain:

$$\beta_1 = \frac{1}{1 + \rho c_{11} \sigma_1^2}, \beta_2 = \frac{1}{1 + \rho c_{22} \sigma_2^2} \quad (12)$$

According to formula (12), If the two goal are mutually independent, the fixed minimum of the subsidy that enterprises can receive is  $\alpha = \bar{\omega} - \frac{\beta^2}{2b}(1 - b\rho\sigma_\theta^2)$ , and if the fixed subsidy cannot reach the  $\bar{\omega} - \frac{\beta^2}{2b}(1 - b\rho\sigma_\theta^2)$ , It means that enterprise' efforts is not compensated.

Finally, if the two objectives effort costs of enterprises in achieving the voluntary environmental program are

is the actual income of enterprises. Thus, certainty equivalent income of enterprise can be expressed as:

When consider the incentive constraints it requires enterprises (proxy) achieve its certainty maximize equivalent in voluntary environmental program by receiving the incentive contracts of government (principal), namely: to

ment (principal) in the voluntary environmental program, is greater than or equal to retain income  $\bar{\omega}$ , namely:

associated, then  $c_{12} \neq 0, c_{21} \neq 0$ . When  $c_{12} > 0$ ,  $\beta_1$  decrease with  $|c_{12}|$  increases, which indicates that it has an alternative between enhance the economic cost of environmental objectives and efforts to protect the ecological costs in the process for enterprise to achieve the two goals.

Research on business incentives of enterprise who participate in the voluntary environmental program from the agency perspective is inevitable departure from the development and practice of voluntary environmental program, for the partial perspective. Because the agency perspective this article selected, default the enterprises have the ability to protect the ecological environment in the context of the developing the economy smoothly, and the reason why they lack the motivation for the protection of the ecological environment is simply lacking of incentives, which should not be in line with China's national conditions. At present the limited technical to develop the industry making the most of the pillar industries are still in the traditional linear model of economic growth depending on resource consumption. And the alternative clean energy has not been found.

### Acknowledgement

Hunan provincial philosophy & social sciences funded base project (13JD12): Research on ecological bonus to promote sustained economic growth path in Hunan.

### References

1. Patriekten Brink. *Voluntary Environment Agreement: Process, Practice and Future Use* [M]. UK: Greenleaf Publishing, 2002.
2. Jordan A., Wurzel R. & Zito A.R. "New" *Instruments of Environment al Governance? National Experiences and Prospects* [M]. London: Frank Cass Publishers, 2003.

3. Borkey P., Glachant M. & Leveque F. *Voluntary Approaches for Environmental Policy in OECD Countries: An Assessment* [R]. The Report of 14th Session of WPEEPI, 1998.
4. Cf. Mahendra & P. Singh, *German Administrative Law: in Common Law Perspective*, Springer-Verlag Berlin Heidelberg, 1985, pp.51-52.
5. Zhou Hongchun. Mobilize the enthusiasm of all sectors to achieve energy conservation [J]. *Environmental Protection*, 2007, (12):26-27.
6. Zhu Yuezhong. The current key issues and recommendations to be concerned about energy saving work [J]. *Macroeconomic Research*, 2009, (3):58.
7. Zhang Weiyong. *Game Theory and Information Economics* [M]. Shanghai: Shanghai Joint Publishing, Shanghai People's Publishing House, 2004.