

Global Public Supports for Innovation in Environmental Technology

Hiroshige TANAKA

Professor of Faculty of Economics, Chuo University, Higashinakano
742-1, Tokyo 192-0393, JAPAN.

Abstract

As the innovation proceeds, decrease of CO₂ emission and lower the average cost of decrement are expected to be attained. The public support system to promote environmental innovation in the global markets should be constructed with international cooperation. However, the existence of uncertainty and the diversity of potential technologies are the obstacle to initiate the innovation in the global market mechanism. We must construct effective schemes to estimate many various and possible technologies to clear the difficulties. This paper proposes a simple and common index of cost and benefit to improve the environmental innovation in the global markets.

The governments and the private green funds could use the marginal benefit and the effects of decrement of emission in the global scale as the efficient indexes on financial supports for the environmental innovation ¹.

1.Introduction

Innovations in environmental technology are expected not only to

¹ The original idea of this approach is stated in Tanaka (2011).

solve global environmental problems but also to activate recovery of global economies ². The innovation is estimated to make effect on the structures of global market economies in a large scale. The larger the scale of global market grows, the keener the many multinational corporations compete. The competition developed over the world tends to depress the market prices downwardly. In the present the new coming technology of environment is not necessary to be more advantageous in competition than the commonly used technology in market economies and may not affect the market mechanism efficiently. Innovations in the field of environment are expected to lower the cost of the products and to increase demand for the new green market.

However the development of new technology requires a great amount of investment. Although the investment has an effect to restore world economies, it is not certain that a global new market to compensate the cost of the investment for each corporation could be developed in a suitable term. As many uncertainties surrounding the investment prevent the innovation from initiating globally. The approaches which governments or public funds share the cost of investment partially are effective to accelerate innovation of environmental technology under the uncertainties ³. Major countries spent green innovating policies to stimulate economies in 2009-2010. The international cooperative governmental expenditures seem to be effective to avoid the great world crisis ⁴.

² Cato (2009) stresses the global view in the green approach to economies.

³ Mendonça, et al.(2010) researches the feed-in tariff as the method to promote renewable energies.

⁴ Barbier(2010) states comprehensive view of global green new deal.

The spending in the slump of economies expands budget deficiency in some countries. The holders of government bond worry about financial stringency, and the tax payers are afraid of increasing tax burden in the future.

To continue governmental supports promoting innovation in the environmental technology governments should make clear the effect of the spending. To simplify the argument we focus on the problems of governmental grants mainly.

This article extends the framework proposed in Tanaka(2010) further to investigate the efficient grant scheme theoretically by the following assumptions. 1. The new technology might need a great amount of investment. 2. The cost of investment could be collected in a global market which is cooperatively constructed in some major countries ⁵. 3. The cost of investment possibly is the burden on this global market as a sunk cost. 4. The global economy consists of two countries to be a developed country and emerging one.

Main result in this paper is summarized as follows. When the net benefit estimated in the following method is greater than the sunk cost in the development of investment, we argue that government or public fund should compensate the sunk cost. In the two countries model the net benefit is approximately estimated by the area of the triangle in which the base is the decrement of CO₂ emission and the height is the initial marginal benefit of the globally integrated community. It is concluded that the rate of the area of the triangle to public support for investment is an effective measure to accelerate innovation of environmental technology. Consequently, the global

⁵ Tanaka(2010) proposes a cost sharing scheme for innovation.

market promotes innovation efficiently.

2.Policies on the Separate Markets

We consider that the cooperative scheme promote effectively innovation of environmental technology in global markets. The development of the technology is expected to create new industry and to lead the domestic county to prosperity. The governments attempt to employ the policies for innovation to seek for the interest of their own countries. The multinational corporation which has succeeded in the development of new technology by the grant of one country could be more competitive and to gain great profit in the global market. The benefit of the grant by one country spreads all over the global society. How to share the burden the grant is considered later in some detail. By the way, if many domestic markets are not integrated into a common market, the cost of the grant could not be covered by benefit of a single country. The government should not only grant the part of investment but arrange the common market globally. To make clear the property of common market, it is appreciate to consider the markets before the integration.

To investigate theoretically we use a model analysis as follows ⁶. It is supposed that there are the two countries which are developed country 1 and emerging country 2. The decrement of CO₂ emission in the country 1 and 2 exhibited by the representative corporation 1 and 2 which belong to each country. The decrement of CO₂ emission for corporation 1 and 2 is denoted by x_1 and x_2 . P_1 and P_2 express

⁶ Baumol(2010) investigates spillover effects of innovation. This paper focus on the global framework of innovation.

the return by one unit decrement of carbon for each corporation such as saving of material cost or environmental tax and revenue from emission trade. K_1 and K_2 show the investment cost of each corporation for research and development or facility to decrease CO_2 . If the tax standard or the cap of emission for each corporation is decided by $\bar{x}_1$ and $\bar{x}_2$, the corporation i ($i=1,2$) pays the tax $P_i(\bar{x}_i - x_i)$ for $\bar{x}_i > x_i$ or receive sale $P_i(x_i - \bar{x}_i)$ from the emission trade in the case $x_i > \bar{x}_i$ holds. The variable cost functions for the corporation 1 and 2 are written by $C_1(x_1, K_1)$ and $C_2(x_2, K_1)$. The total cost are stated by

$$P_i(\bar{x}_i - x_i) + C_i(x_i, K_i) + K_i, \quad i=1,2. \quad (1)$$

K_i is supposed to be a parameter for a short production period. It is assumed that the variable functions are increasing regarding to decrement of emission x_i and decreasing regarding to investment. Inequalities in (2) are assumed to be satisfied.

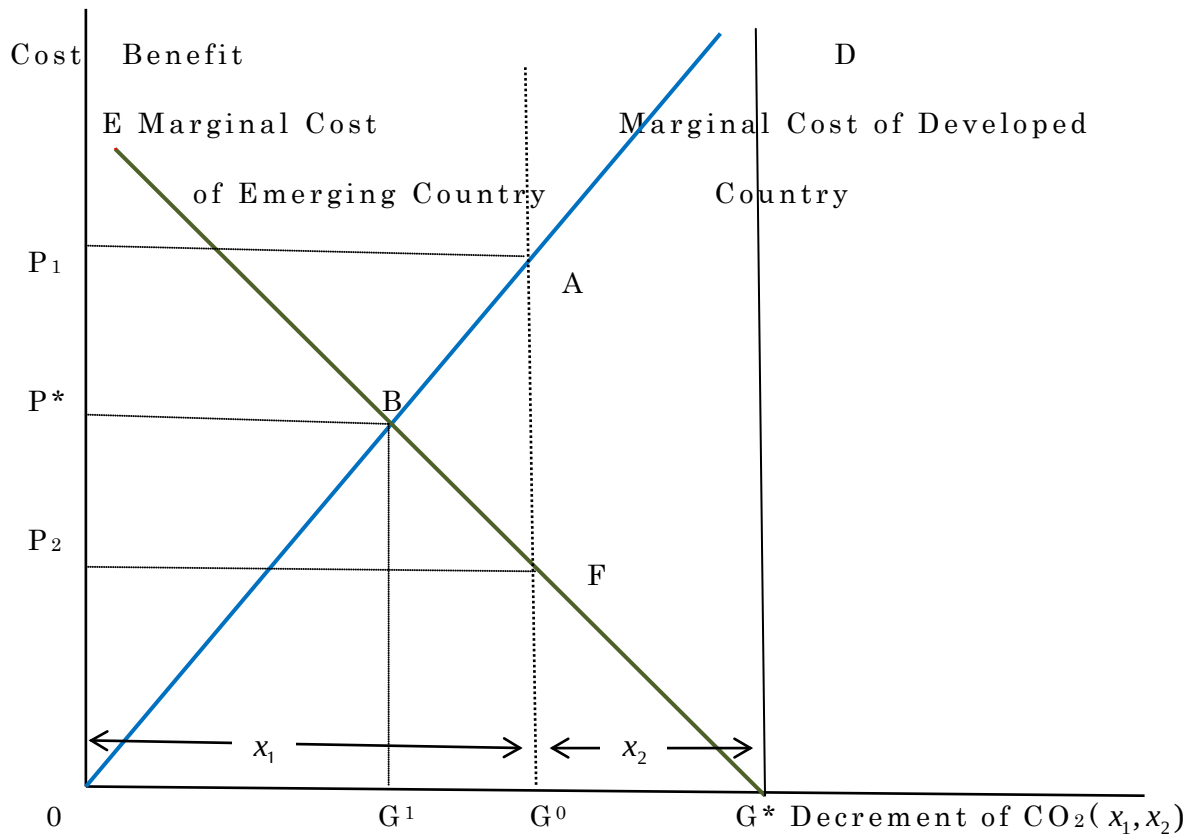


Figure1 Two markets mechanism

$$\frac{\partial C_i}{\partial x_i} > 0, \frac{\partial C_i}{\partial K_i} < 0, \quad i=1,2. \quad (2)$$

The optimal condition to minimize the cost of decreasing emission is noted by

$$P_i = \frac{\partial C_i}{\partial x_i}, \quad i=1,2. \quad (3)$$

Supposed that the two countries are targeted to decrease the emission of CO₂ in the separate two markets. Figure 2 depicts that county 1 and 2 decrease 0G⁰ and G⁰G* of emission. The two price P_1 and P_2 induce cooperation 1 and 2 to reduce the emission by satisfying (2). To decrease the same total G* the two country reduce 0G¹ and G¹G* at a single price P^* in a common market. The two separate markets solution losses the welfare of triangular area BFA by comparing with common market solution.

3. Effective Provision of the Grant

When we consider the large amount of incubating investment in environmental technology, it is probably happened that the optimal solution B in Figure 1 could not be achieved without any governmental grant or public fund. To investigate the role of grant or public funds in the global society, the optimal condition is stated as follows.

The global social welfare function is written by $W(x_1+x_2)$. Net global social benefit is expressed by

$$W(x_1+x_2) - \sum_{i=1}^2 \{C_i(x_i, K_i) + K_i\}. \quad (4)$$

The first order optimal condition regarding to x_1 and x_2 is satisfied with

$$\frac{\partial W}{\partial x_i} = \frac{dW}{d(x_1 + x_2)} = \frac{\partial C_i}{\partial x_i}, \quad i=1,2. \quad (5)$$

If the second side of (5) is equal to the global market price P^* , the maximization of welfare is achieved in the common global market.

However, the enormous amount of investment should be noticed on the feasibility of global market. The bottle neck in the innovation of environmental technology is explained as follows. The incubating investment to initiate innovation could not proceed without compensation by governments or public funds. Figure 2 depicts the effect or the necessity of the public support on the innovation of

Cost Benefit Marginal Cost of Emerging Counties

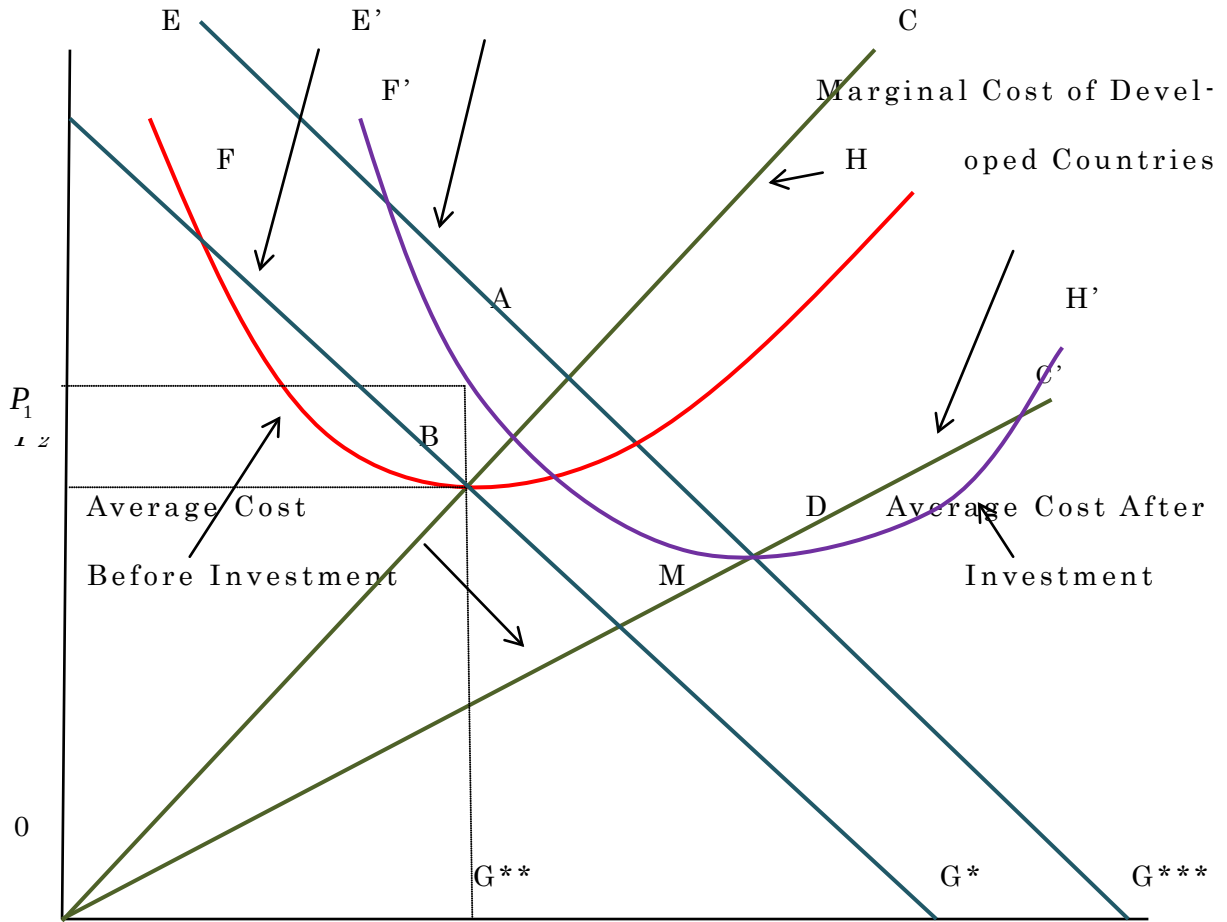


Figure 2 Innovation and grant

Decrement of CO_2 (x_1, x_2)

environmental technology. In the beginning the corporation of the advanced country equilibrate budget to reduce emission of CO_2 . It is assumed that a development of technology lowers the marginal cost curve OC to OC' and the average cost curve EH to $E'H'$ to reduce emission of CO_2 . In a long term the equilibrium point B moves to the point D . In the first stage the global economies the cooperation to invest share burden of the deficit of rectangular area P_1P_2BA . At the second stage the market equilibrium is attained by the point M . Since equilibrium point M is under the average curve $E'H'$ in this time, the corporation must continue to suffer the deficit. At the third stage the agreement to enlarge the total decrement of emission G^* to G^{***} moves equilibrium point M to point D . The deficit disappears and there is no need to support for the corporation to reduce emission of CO_2 .

4.The International Cooperation to Reduce Emission

The grant of investment in the advanced country lowers the deficit from investment and assists the innovation in environmental technology. The grant might accompany the risk of enlargement of budget crisis. Taxpayers and holders of national bonds are afraid of the risk. The governmental positive support to improve investment of environmental technology is placed under the negative pressers of markets and taxpayers.

The policy makers are obliged to make clear the most effective way to achieve innovation publicly. Figure 3 depicts the cost and benefit

area of $AG^*G^{**}C$ is equal to the area of $EG^*G^{**}F$. Reminding that the length of AC is equal to G^*G^{**} , the areas of triangles AOC and FG^*G^{**} with same height P_2O are identical. The increased cost is stated by the subtraction from the rectangular area $EG^*G^{**}F$ to the triangular area AOC . We conclude that the net benefit of the grant to improve innovation is approximately estimated by the area of triangular DG^*F which is summation of areas of the two triangles DEF and EG^*F . The net benefit in the global society is calculated by the expression (1).

$$\begin{aligned} & 1/2 \times \text{global marginal benefit of decrement of CO}_2 \text{ emission (DG}^*) \\ & \times \text{agreeable decrement of emission (G}^*G^*). \end{aligned} \quad (1)$$

The above expression implies that the key indexes to proceed public supports for environmental innovation are the global marginal benefit of decrement of CO_2 emission and the global agreeable decrement of emission. At a constant global marginal benefit an effort to reduce CO_2 emission in the global society improves the estimated benefit of innovation in the environmental technology and heightens the evaluation of the grant by governments.

Although the net benefit spreads over the global society, the grant burdens a particular country. In many cases the grant seems to be undervalued by the national interest comparing with the global net benefit. The project is not able to be accepted by one country might be effective from global point of view. The following policies are

appropriate to avoid such an undervaluation of public support to environmental innovation. In the first, cooperative provision of the grant is effective with relatively small burden for each country. The global green new deal advocates this type of approach and the urgent expenditures 2009 of G20 for the world economic crisis have a similar purpose. In the second the grant is provided by a global fund. The green fund for the climate change should be the most important concern to construct the framework of climate change. In the third to construct a common market mechanism obtains a priority to other international agreement.

5. Concluding Remarks

Innovation of environmental technology has priority over the policies of climate change. Although the innovation is expected to recover the world economies in the economic crisis 2009, the burden of the grant is not willing to be accepted with a single country. Since the cumulative grants might lead to a worse budget crisis, government could not easily persuade taxpayers or national bond holders to continue the budgetary support for the innovation of environmental technology. In the fact, the innovation is a vital solution for the climate change and could not be promoted without fund or grant. The global common market for decrement of CO₂ emission and the globally shared fund to support the innovation are indispensable foundation to progress the innovation.

The approach presented here is a common standard in diverse developments of innovation and global economies. The simple index is easily connected with market mechanism. We must develop

affluent implication of this method in investigation on actual economic society.

References

- Barbier, E.B. (2010), *A Global Green New Deal: Rethinking the Economic Recovery*, United Nations Environment Programme, Cambridge University Press.
- Baumol, W.J. (2010), *The Microtheory of Innovation Entrepreneurship*, Princeton University Press.
- Cato, M.S. (2009), *Green Economics: An introduction to Theory, Policy and Practice*, Earthscan.
- Mendonça, M., D. Jacobs and B. Sovacool (2010), *Powering the Green Economy: The feed-in tariff handbook*, Earthscan.
- Tanaka, H. et al. (1998), *Public Economics*, Toyokeizai Sinpoushya, (written by Japanese).
- Tanaka, H. (2010), "A Global Cost Sharing Scheme to Prompt Innovation in Environmental Technology" *London Accord*, http://www.london-accord.co.uk/index.php?option=com_content&view=article&id=225&Itemid=61
- Tanaka, H. (2011) "An Index of Cost Benefit with regard to innovation of environmental technology," A Brief Lecture on Environmental Economics (NO.14) *Global Environmental Policy in Japan*, (written by Japanese, in printing)