FIRMS' ENIRONMENTAL PERFORMANCE AND REGIONAL RESIDENTS

Kenichi SHIMAMOTO
Associate Professor, Konan University, Japan
kenichi@center.konan-u.ac.jp

Abstract

As the scale of economic activities continue to grow, the burden on the environment for the surrounding region increases, so it has become necessary for firms and the regional community to have bilateral negotiations taking economic activities and environmental issues into consideration in order to find an efficient solution. This paper attempts to use the Nash bargaining solution concept between firms and the surrounding residents to analyse the optimal solution when considering the firms' economic activity and environmental performance. It includes a model to analyse the impact that a firm's environmental performance has on improving its economic performance. It also takes into consideration the effects that an improved environmental performance will have on the regional residents, through reduced pollution, employment opportunities and tax revenue. The results for both cases, when environmental regulations are absent and when they are enforced, find that the party that receives the greater benefit will transfer income to the other party which supports the benefits principle. Thus, in order to examine the mechanism of income transfer between firms and the regional residents, it will be important to comprehensively consider the affect that firms' environmental performance have on their economic performance, the environmental cost for firms to improve their environmental performance and the benefits to regional residents from environmental regulations.

Keywords: Environmental performance, Economic performance, Bargaining game, Income transfer

JEL classification: M2, Q5, R1

1. Introduction

Firms have always had a close relationship with the local community and the region it resides in. The role firms have played in stimulating the region is important and there are a number of previous empirical studies on this (e.g. Karlsson and Dahlberg, 2003; Sternberg, 2009; Leigh and Blakely, 2013; Rypestol, 2017). However, firms have also had a negative impact on the regional residents causing environmental problems such as air and water pollution and damage to the natural environment. This leads to a need for both economic activities and environmental issues to be taken into consideration and firms and regional residents work towards a solution through bilateral negotiations. It has been identified that the game theory is an effective method in such situations (Karlin, 1992). This paper, will apply the concept from the Nash bargaining solution for this analysis (Nash, 1950).

If we observe past studies in this area that applies the game theory, there are past studies on the relationship between environmental regulations by the government and the firms' progress in environmental technology (Chew et al, 2011; Zhao et al., 2013). However, they do not mention the relationship that the environmental regulations by the government and the firms' environmental considerations have on the regional residents. Therefore, this paper attempts to analyse the income transfer from firms to the residents as a result of the impact the government's environmental regulations have on the firms' environmental performance.

The following points are considered in the model. First, the model takes into consideration how a firm's environmental performance affects its economic performance. According to the Porter Hypothesis, firms are able to adapt environmental management systems and develop their environmental performance which in turn can be effective in developing their economic performance (Porter, 1991; Porter and Linde, 1995). This relationship between environmental performance and economic performance may affect the negotiations between the firm and the regional residents. For example, a firm may gain recognition as a brand that is environmentally friendly which provides a competitive advantage over the competition which

may be achieved through the development of green technology/products and by actively taking part in environmental activities (Hart, 1995). Evidence to support that environmental performance can improve economic performance is provided in numerous past empirical studies (e.g. Hart and Ahuja, 1996; DeSimone and Popoff, 1997; Russo and Fouts, 1997; King and Lenox, 2001; Konar and Cohen, 2001; Thomas, 2001; King and Lenox, 2002; Schaltegger and Synnestvedt, 2002; Al-Tuwaijri et al., 2004). Furthermore, in this study, the model factors in the value firms place on improved environmental performance. The positive impact from improved environmental performance will not only mean improved economic performance but may also lead to improved brand image and help fulfil corporate social responsibilities. This could affect the income transfer from firms to the regional residents. Secondly, since firms will have an impact on the regional residents, this model includes the following three effects. The first is the pollution reduction effect which will benefit the regional residents from the improved environment with the reduction in pollution by the firm. The second is the employment effect. It can be assumed that the improved economic performance can stimulate a further demand in labour by the firm which will lead to an increase in employment opportunities for the regional residents. There are various empirical research that studies this effect (e.g. Ayyagari et al., 2014; Inekwe, 2014; Masso et al., 2008). The third is the tax revenue effect. The public services of the region can be enhanced with the increase in taxes paid by the firms to the region. For example, in Japan, the individual and corporation enterprise tax imposed by the prefecture is a general tax which can be used in a wide number of public services for the region. However, the residents' subjective value of these three effects, which are the benefit to the residents from the pollution reduction effect; the employment effect; and the tax revenue effect, could differ widely. Hence, this paper attempts to include in its model consideration of the size of these subjective values.

The next section applies Nash's bargaining solution concept between firms and the regional residents, followed by a summary of the results and discussions on the implications provided by the results.

2. Environmental Issues and the Bargaining Game

An assumption will be made that the main cause of environmental damage will come from a firm and the regional residents R based in the neighbouring region will receive damages. Through its production activity, firm C will gain *I(x)*, but will also have a negative impact on the local environment. This could lead to multiple ecological and economic damages to the region as well as cause the residents ill health and may affect their food supply. If the rate for firm C to improve its environmental performance is $x(0 \leq x \leq 1)$, then the cost incurred for the improvement will be $f(x)(f(x) \geq 0)$ and the benefits to the regional residents R from the reduction in pollution will be $g(x)(g(x) \geq 0)$. As a result of the improved environmental performance by the firm, the benefit to residents R from the employment effect will be $e(x)(e(x) \geq 0)$ and the benefits to residents R from the tax revenue effect will be $t(x)(t(x) \geq 0)$. Firm C, the polluter and residents R, will enter a negotiation to determine the improvement rate the firm will need to achieve for their environmental performance and to determine the income transfer for the damages that the residents will receive, taking the benefits created by the firm's activities into account.

The payoff for firm C can be represented as follows.

$$u_C(x) = \alpha I(x) - f(x) \qquad (1)$$

In this case, the value the firm places on the improved economic performance from its environmental performance is α.

The following represents the payoff to residents.

$$u_R(x) = \beta g(x) + \gamma e(x) + t(x) \qquad (2)$$

β denotes the value residents place on the benefit from the improved environment. γ is the value residents place on the benefit from the employment effect born from the firm's improved environmental performance.

Assuming that income transfer from firm C to residents R is possible, then the Pareto optimum improvement rate of environmental performance to achieve Pareto optimum, x^*, can be obtained by maximizing the following total social benefits.

$$u_C(x) + u_R(x) = \alpha I(x) - f(x) + \beta g(x) + \gamma e(x) + t(x) \quad (3)$$

In other words, $x = x^*$, which satisfies $f'(x) - \alpha I'(x) = \beta g'(x) + \gamma e'(x) + t'(x)$. Under these conditions, the payoff to firm C and residents R is as follows.

$$(\alpha I(x^*) - f(x^*), \beta g(x^*) + \gamma e(x^*) + t(x^*)) \quad (4)$$

With the possibility of income transfer between firm C and residents R, the Pareto optimal payoff set can be represented as

$u_C + u_R = \alpha I(x^*) - f(x^*) + \beta g(x^*) + \gamma e(x^*) + t(x^*)$.

The bargaining disagreement point can inform us of how the set of regulations can affect how the point is established. This leads us to examine two different conditions concerning environmental regulations.

Condition I: The absence of environmental regulations

Without any regulations, firms are able to make their own decisions concerning their environmental performance.

Condition II: The adoption of environmental regulations

With environmental regulations in place, environmental impact will be governed. Furthermore, under the absence of an agreement between the firm and the regional residents, firms will need to set their rate to improve their environmental performance as 1.

In Condition I, when the rate of improvement of the environmental performance is 0, the bargaining disagreement point will be the Nash bargaining solution, $d_1 = (\alpha I(0) - f(0), \beta g(0) + \gamma e(0) + t(0))$. The payoff distribution for firm C will be as follows.

$$u_C = \frac{1}{2}\left(\alpha\left(I(x^*) + I(0)\right) - f(x^*) - f(0) + \beta\left(g(x^*) - g(0)\right) + \gamma\left(e(x^*) - e(0)\right) + t(x^*) - t(0)\right) \quad (5)$$

The payoff to local resident R will be as below.

$$u_R = \frac{1}{2}(\alpha(I(x^*) - I(0)) - f(x^*) + f(0) + \beta(g(x^*) + g(0)) + \gamma(e(x^*) + e(0)) + t(x^*) + t(0))) \quad (6)$$

In other words, the payoff for each under the absence of environmental regulations are as follows.

$$\left(\frac{1}{2}\left(\alpha\left(I(x^*) + I(0)\right) - f(x^*) - f(0) + \beta\left(g(x^*) - g(0)\right) + \gamma\left(e(x^*) - e(0)\right) + t(x^*) - t(0)\right), \frac{1}{2}(\alpha\left(I(x^*) - I(0)\right) - f(x^*) + f(0) + \beta\left(g(x^*) + g(0)\right) + \gamma\left(e(x^*) + e(0)\right) + t(x^*) + t(0)\right)\right)$$

The process of achieving Pareto optimal, the agreement point, will be examined. With the possibility of income transfer between firm C and residents R, the amount of income transfer from firm C can be obtained as follows.

$$D_{1,C} = (I(x^*) - f(x^*)) - \frac{1}{2}(\alpha(I(x^*) + I(0)) - f(x^*) - f(0) + \beta(g(x^*) - g(0)) + \gamma(e(x^*) - e(0)) + t(x^*) - t(x)) \quad (7)$$

Thus,

$$D_{1,C} = \frac{1}{2}\left(\alpha\left(I(x^*) - I(0)\right) - \left(f(x^*) - f(0)\right) - \beta\left(g(x^*) - g(0)\right) - \gamma(e(x^*) - e(0)) - \left(t(x^*) - t(0)\right)\right) \quad (8)$$

Since the environmental performance improvement rate is set to achieve Pareto optimal, when the environmental cost to the firm is higher in this case than the environmental cost to the firm with the absence of environmental regulations; and the benefit to the residents when the firm achieves Pareto optimal is higher than the benefit to the residents with the absence of regulations, from

$$(0 < f(0) < f(x^*)) \cap (0 < g(0) < g(x^*)) \cap (0 < e(0) < e(x^*)) \cap (0 < t(0) < t(x^*))$$

the following relationship can be achieved.

$$D_{1,C} > 0 \; if \; \alpha\left(I(x^*) - I(0)\right) > \left(f(x^*) - f(0)\right) - \beta\left(g(x^*) - g(0)\right) - \gamma\left(e(x^*) - e(0)\right) - \left(t(x^*) - t(0)\right) \quad (9)$$

$$D_{1,C} < 0 \; if \; \alpha\left(I(x^*) - I(0)\right) < \left(f(x^*) - f(0)\right) - \beta\left(g(x^*) - g(0)\right) - \gamma\left(e(x^*) - e(0)\right) - \left(t(x^*) - t(0)\right) \quad (10)$$

Furthermore, for residents R, the amount of income transfer is as follows.

$$D_{1,R} = g(x^*) - \frac{1}{2}(\alpha(I(x^*) - I(0)) - f(x^*) + f(0) + \beta(g(x^*) - g(0)) + \gamma(e(x^*) - e(0)) + t(x^*) - t(0)) \quad (11)$$

Hence,

$$D_{1,R} = -\frac{1}{2}\left(\alpha\left(I(x^*) - I(0)\right) - \left(f(x^*) - f(0)\right) - \beta\left(g(x^*) - g(0)\right) - \gamma\left(e(x^*) - e(0)\right) - \left(t(x^*) - t(0)\right)\right) \quad (12)$$

and in the same way, from

$$(0 < f(0) < f(x^*)) \cap (0 < g(0) < g(x^*)) \cap (0 < e(0) < e(x^*)) \cap (0 < t(0) < t(x^*))$$

the following is obtained.

$$D_{1,R} < 0 \; if \; \alpha\left(I(x^*) - I(0)\right) - \left(f(x^*) - f(0)\right) > \beta\left(g(x^*) - g(0)\right) + \gamma\left(e(x^*) - e(0)\right) + \left(t(x^*) - t(0)\right) \quad (13)$$

$$D_{1,R} > 0 \; if \; \alpha\left(I(x^*) - I(0)\right) - \left(f(x^*) - f(0)\right) < \beta\left(g(x^*) - g(0)\right) + \gamma\left(e(x^*) - e(0)\right) + \left(t(x^*) - t(0)\right) \quad (14)$$

From (9), (10), (13) and (14) the following proposition can be achieved.

Proposition 1:

$$(D_{1,C} > 0) \cap (D_{1,R} < 0) \; if \; \alpha\left(I(x^*) - I(0)\right) - \left(f(x^*) - f(0)\right) > \beta\left(g(x^*) - g(0)\right) + \gamma\left(e(x^*) - e(0)\right) + \left(t(x^*) - t(0)\right) \quad (15)$$

$$(D_{1C} < 0) \cap (D_{1R} > 0) if \left(I(x^*) - I(0)\right) - \left(f(x^*) - f(0)\right) < \beta\left(g(x^*) - g(0)\right) + \gamma\left(e(x^*) - e(0)\right) + \left(t(x^*) - t(0)\right) \quad (16)$$

Taking into consideration the value firms place on addressing environmental concerns and the economic performance gained from the improved environmental performance (the difference in economic performance to the firm under the absence of environmental regulations and the economic performance to the firm under pareto optimal environmental consideration) and subtracting the increase in cost for the environmental consideration (the difference in cost to the firm under pareto optimal environmental consideration to the cost to the firm under the absence of environmental regulations) is greater than the total benefit to the residents, in other words the benefits from the three effects, which are the pollution reduction effect, employment effect and tax revenue effect; and the subjective value residents place on these effects (the difference in benefit to the residents when firms are performing at their pareto optimal environmental consideration to the benefit to the residents when firms are performing under the absence of environmental regulations), there will be a transfer of income from the firms to the residents.

On the other hand, the increase in economic performance by firms proactively addressing environmental issues taking into consideration the value firms place on such performance (the difference in the firm's economic performance under the absence of environmental regulations and the economic performance when environmental consideration is at the firm's pareto optimal) subtracted by the increase in cost from the environmental considerations (the difference in cost to the firm when environmental consideration is at the firm's pareto optimal to the cost to the firm under the absence of environmental regulations) is less than the total benefit to the residents, which is the benefits from the three effects and the subjective value residents place on these effects (the difference in benefit to the residents when firms are performing at their pareto optimal environmental consideration to the benefit to the residents when firms are performing under the absence of environmental regulations), there will be an income transfer from the residents to the firms.

As indicated in (15), a transfer of income occurs from the firm to the residents when the difference in economic performance to the firm at the Pareto optimal environmental performance improvement rate to the economic performance under the absence of environmental regulations is greater than the difference in benefit to the residents at the firm's Pareto optimal environmental consideration to the benefit under the absence of regulations. However, a transfer of income from residents to the firm is suggested from (16), when the difference between the economic performance to firms when addressing environmental concerns to achieve Pareto optimal and the economic performance under the absence of environmental regulations is less than the difference between the benefits to the residents at the firm's Pareto optimal environmental consideration and under the absence of environmental regulations.

If we observe a situation where firms achieve positive growth from their brand recognition as a result of their improved environmental performance compared to when there was an absence of environmental regulations and the economic performance from this growth is greater than the benefit the residents receive from the improved environment, then there is an income transfer from the firm to the residents. However, compared to when there is an absence of environmental regulations, there is a transfer of income from the residents to the firm, if the improved environmental performance has a positive impact on the environment which the residents benefit from and if the increase in benefit is greater than the difference between the economic performance to the firm under the absence of environmental regulations and the economic performance when they improve their environmental performance to achieve Pareto optimal.

In Condition II, where environmental regulations are enforced, the bargaining disagreement point is the Nash bargaining solution, $d_2 = (\alpha I(1) - f(1), \beta g(1) + \gamma e(1) + t(1))$, when the rate of improvement of environmental performance is 1. In this situation, firm C's payoff distribution is as follows.

$$u_C = \frac{1}{2}(\alpha(I(x^*) + I(1)) - f(x^*) - f(1) + \beta(g(x^*) - g(1)) + \gamma(e(x^*) - e(1)) + t(x^*) - t(1)) \quad (17)$$

Moreover, resident R's payoff is the following.

$$u_R = \frac{1}{2}(\alpha(I(x^*) - I(1)) - f(x^*) + f(1) + \beta(g(x^*) + g(1)) + \gamma(e(x^*) + e(1)) + t(x^*) + t(1)) \quad (18)$$

In other words, the following payoff for each is achieved when regulations are enforced.

$$\left(\frac{1}{2}(\alpha(I(x^*) + I(1)) - f(x^*) - f(1) + \beta(g(x^*) - g(1)) + \gamma(e(x^*) - e(1)) + t(x^*) - t(1)), \frac{1}{2}(\alpha(I(x^*) - I(1)) - f(x^*) + f(1) + \beta(g(x^*) + g(1)) + \gamma(e(x^*) + e(1)) + t(x^*) + t(1))\right)$$

Using the same method as in the case of the absence of environmental regulations with the enforcement of regulations, the process that achieved the bargaining agreement point, which is the Pareto optimal point will be examined. The income transfer amount for firm C will be obtained as follows.

$$D_{2C} = (I(x^*) - f(x^*)) - \frac{1}{2}(\alpha(I(x^*) + I(1)) - f(x^*) - f(1) + \beta(g(x^*) - g(1)) + \gamma(e(x^*) - e(1)) + t(x^*) - t(1)) \quad (19)$$

Hence,

$$D_{2C} = -\frac{1}{2}\left(\alpha(I(1) - I(x^*)) - (f(1) - f(x^*)) - \beta(g(1) - g(x^*)) - \gamma(e(1) - e(x^*)) - (t(1) - t(x^*))\right) \quad (20)$$

In the situation where the environmental cost to the firm when environmental regulations are enforced is higher than the environmental cost to achieve Pareto optimal, and the benefit to the residents when environmental regulations are enforced is greater than the benefit at the firm's Pareto optimal, then from

$$(0 < f(x^*) < f(1)) \cap (0 < g(x^*) < g(1)) \cap (0 < e(x^*) < e(1)) \cap (0 < t(x^*) < t(1))$$

the following relationship is achieved.

$$D_{2C} < 0 \text{ if } \alpha(I(1) - I(x^*)) - (f(1) - f(x^*)) > \beta(g(1) - g(x^*)) + \gamma(e(1) - e(x^*)) + (t(1) - t(x^*)) \quad (21)$$

$$D_{2C} > 0 \text{ if } \alpha(I(1) - I(x^*)) - (f(1) - f(x^*)) < \beta(g(1) - g(x^*)) + \gamma(e(1) - e(x^*)) + (t(1) - t(x^*)) \quad (22)$$

The income transfer amount for local resident R will be as follows.

$$D_{2R} = g(x^*) - \frac{1}{2}(\alpha(I(x^*) - I(1)) - f(x^*) + f(1) + \beta(g(x^*) - g(1)) + \gamma(e(x^*) - e(1)) + t(x^*) - t(1)) \quad (23)$$

Hence,

$$D_{2,R} = \frac{1}{2}\Big(\alpha\big(I(1) - I(x^*)\big) - \big(f(1) - f(x^*)\big) - \beta\big(g(1) - g(x^*)\big) - \gamma\big(e(1) - e(x^*)\big) - \big(t(1) - t(x^*)\big)\Big) \tag{24}$$

In the same way, from
$(0 < f(x^*) < f(1)) \cap (0 < g(x^*) < g(1)) \cap (0 < e(x^*) < e(1)) \cap (0 < t(x^*) < t(1))$

the following relationship is achieved.

$$D_{2,R} > 0 \; if \; \alpha\big(I(1) - I(x^*)\big) - \big(f(1) - f(x^*)\big) > \beta\big(g(1) - g(x^*)\big) + \gamma\big(e(1) - e(x^*)\big) + \big(t(1) - t(x^*)\big) \tag{25}$$

$$D_{2,R} < 0 \; if \; \alpha\big(I(1) - I(x^*)\big) - \big(f(1) - f(x^*)\big) < \beta\big(g(1) - g(x^*)\big) + \gamma\big(e(1) - e(x^*)\big) + \big(t(1) - t(x^*)\big) \tag{26}$$

From (21), (22), (25) and (26) the proposition below can be obtained.

Proposition 2:

$$(D_{2,C} < 0) \cap (D_{2,R} > 0) \; if \; \alpha\big(I(1) - I(x^*)\big) - \big(f(1) - f(x^*)\big) > \beta\big(g(1) - g(x^*)\big) + \gamma\big(e(1) - e(x^*)\big) + \big(t(1) - t(x^*)\big) \tag{27}$$

$$(D_{2,C} > 0) \cap (D_{2,R} < 0) \; if \; \alpha\big(I(1) - I(x^*)\big) - \big(f(1) - f(x^*)\big) < \beta\big(g(1) - g(x^*)\big) + \gamma\big(e(1) - e(x^*)\big) + \big(t(1) - t(x^*)\big) \tag{28}$$

When the economic performance gained by the firms' actively addressing environmental concerns taking the value firms place on addressing environmental issues into consideration (the difference in economic performance to the firm under stringent environmental regulations and the economic performance when environmental consideration is at the firm's Pareto optimal) subtracted by the increase in cost for the environmental consideration (the difference in cost to the firm when environmental regulations are enforced to the cost to the firm when environmental consideration is at the firm's Pareto optimal), is greater than the total benefit to the residents, in other words the three effects which are the pollution reduction effect, employment effect and tax revenue effect and taking into account the subjective value residents place on these effects (the difference in benefit to the residents when firms need to adhere to environmental regulations, to the benefit to the residents when the firm's environmental consideration is at the firm's Pareto optimal), there will be a transfer of income from the firms to the residents.

On the other hand, the value firms place on their environmental performance and the increase in economic performance gained by firms proactively addressing environmental issues (the difference in economic performance to the firm when environmental consideration is at the firm's pareto optimal and the economic performance to the firm under the enforcement of environmental regulations) subtracted by the increase in cost from the environmental considerations (the difference in cost to the firm under the enforcement of environmental regulations to the cost to the firm when environmental consideration is at the firm's pareto optimal) is less than the total benefit to the residents from the three effects, which are the pollution reduction effect, employment effect and tax revenue effect and the subjective value residents place on these effects (the difference in benefit to the residents when firms are performing at their pareto optimal situation for environmental consideration to the benefit to the residents when firms are performing under the enforcement of environmental regulations), there will be an income transfer from the residents to the firms.

A transfer of income from the firm to the residents will occur as depicted in (27), if the difference between the economic performance to the firm when environmental regulations are enforced and the economic performance when the environmental consideration is to achieve Pareto optimal is greater than the difference in the benefit to the residents under the enforcement of environmental regulations and the benefit when the firm is at Pareto optimal

environmental consideration. However, (28) identifies a transfer of income from the residents to the firm if the difference in economic performance to the firm under the enforcement of environmental regulations and the economic performance when the firm is at Pareto optimal is less that the difference in benefit to the residents under the enforcement of environmental regulation and the benefit when the firm is at Pareto optimal environmental consideration.

These results suggest that when environmental regulations are enforced and firms improve their environmental performance, they may be able to enjoy an improved brand awareness and increase in productivity which can lead to positive growth compared to when firms are running at their Pareto optimal rate of environmental consideration. If the economic performance obtained from this growth is greater than the benefit achieved by the residents from the improved environment, then there is an income transfer from the firm to the residents. However, the improved environment from the enforced environmental regulations could provide an increased benefit to the residents compared to when firms perform at their Pareto optimal environmental performance. If this benefit is greater than the difference in economic performance to the firm under environmental regulation and the economic performance at Pareto optimal, then there is an income transfer from the residents to the firm.

These results suggest that when environmental regulations are introduced, there will be a transfer of income from the party that achieves the greater benefit to the other party. This would support the benefits principle, as in the case of when there is an absence of environmental regulations.

3. Conclusions

Firms' economic activities are known to have positive impact on the neighbouring region, but also having negative impact such as on the environment. Hence, it is necessary for firms and the region to undergo discussions to achieve an efficient solution with consideration for both economic activities and environmental issues. This paper analyses the total benefit to society comprising both firms and regional residents; the process for firms to achieve an optimal condition concerning their environmental endeavours; and the transfer of income between firms and regional residents, applying the bargaining game.

In the examination, the impact that a firm's environmental performance has on its economic performance is considered in the model as well as the firm's subjective value concerning improved environmental performance. For the impact firms have on the surrounding region, there are the benefits achieved from the improvements to the regional residents' environment from the reduction in pollution; the impact on employment opportunities for the local residents; and the impact on tax revenue. Furthermore, the residents' subjective values of these benefits are taken into consideration. Hence, these factors are also examined in the model.

As a result, under the absence of environmental regulations, when firms' rate of environmental improvement is to achieve Pareto optimal, the economic performance gained which takes into consideration the value firms place on addressing environmental performance is greater than the total benefit to the residents at the firms' Pareto optimal rate of environmental consideration which includes the pollution reduction effect, employment effect and tax revenue effect and the subjective value residents place on these effects, there will be an income transfer from the firms to the residents. On the other hand, under the absence of environmental regulations, when the total benefits to the residents which includes the three effects and the subjective value placed on these effects at the Pareto optimal environmental performance is greater than the difference in economic performance for firms performing under the absence of regulations and performing at the Pareto optimal rate of environmental improvement which takes into consideration the firms' subjective value of improved environmental performance, there will be an income transfer from the residents to the firms. Under the enforcement of environmental regulations, compared to firms performing at the Pareto optimal rate of environmental improvement, if the economic performance gained by the firms from the improved environmental performance such as through enhanced brand awareness and increased productivity, taking into consideration the value firms place on the improved environmental performance is greater than the total benefit to the residents under the enforcement of environmental regulations which includes the three effects and the subjective value residents place on the impact of these effects, then there will be an income

transfer from the firm to the residents. However, if the total benefits to the residents which includes the three effects and the subjective value of the three effects is greater than the difference in economic performance to firms under the enforcement of environmental regulations and the economic performance under Pareto optimal environmental performance taking into account the firm's subjective value placed on the improved environmental performance, there will an income transfer from the residents to the firm.

In this way, for both conditions where there is an absence of environmental regulations and when they are enforced, the party that has the greater benefit transfers income to the other party which supports the benefits principle.

Under these conditions, it is important to note that even when there is an absence of regulations, if there is an improvement to economic performance due to the effect of environmental regulations and the value firms place on the improved environmental performance, then there is a transfer of income from firms to the regional residents. Hence, even under the absence of regulations, if the economic performance gained due to firms proactively responding to the environment with the added subjective value firms place on the improved environmental performance is greater than the total benefit to the regional residents due to this proactive response, which includes the pollution reduction effect, employment effect and the tax revenue effect and the subjective value residents place on these effects, then there is a transfer of income from the firms to the regional residents. Moreover, even under the enforcement of environmental regulations, if we consider the possibility of improved economic performance due to adapting to the regulations, there are situations where there is a transfer of income from the residents to the firms. In other words, even under the enforcement of environmental regulations, if the increased economic performance including the subjective value firms place on environmental performance is less than the total benefit to the regional residents from the three effects and their subjective value placed on these effects, then there is a transfer of income from the regional residents to the firms.

From these results, in order to examine the mechanism of income transfer between firms and regional residents, it will be important to comprehensively consider the impact that firms' environmental performance has on its economic performance, the subjective value firms place on its environmental performance, the environmental cost for firms to improve their environmental performance and the total benefits to regional residents from the environmental regulations which includes the reduced pollution, increased employment opportunities and increased tax revenue and the subjective value residents place on these effects .

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