ENVIRONMENTAL REGULATION, BUSINESS INNOVATION AND INTERNATIONAL COMPETITIVENESS

1. Introduction

As environmental regulatory policies have been implemented in both developed and developing countries more and more commonly, how environmental regulations and international competitiveness are related attracts lots of attention (e.g., Jaffe *et al*., 1995, and Porter and van der Linde, 1995). It has also become a hot topic in the international trade theories as well (e.g., Copeland and Taylor, 1994, 2003, 2004). One of the controversial issues is whether the implementation of environmental regulations in a country would lower the international competitiveness of its firms.

This paper investigates under what conditions the implementation of environmental regulation in a country can actually help improve its firm's international competitiveness. With a Cournot quantity duopolistic model in an international situation, we show that if the environmental regulation takes a form of tradable baseline-and-credit system, the implementation of environmental regulations and the pollution reducing technology may play a strategic role that commits the firm to behave like a 'top dog' (Fuderberg and Tirole, 1984; Tirole, 1988). As a result, it may enhance the firm's international competitiveness as measured by its product market share and profitability.

The topic in this paper is related to the literature on environmental regulations, technological innovation as well as firms' international competitiveness. A conventional view holds that more restrictive environmental regulations in a country would lower the international competitiveness of its firms. For example, Siebert (1977) and McGuire (1982) pointed out that if the government carries out more stringent environmental regulations to firms in the home country, it will increase the cost and hence decrease the profits of domestic firms. As a result, it may lower their international competitiveness. On the other hand, if the government of a foreign country adopted more lenient environmental standards, it would help to enhance the

international competitiveness of foreign enterprises (Barret, 1994).

Porter and van der Linde (1995) put forward the role of innovation to the traditional view and made an amendment. They held that the traditional analysis was static and that from a dynamic point of view, technology, products and production processes are all in change. A strict environmental control will force firms to be innovative so as to offset the cost increase caused by more stringent environmental standards. It may even enhance the international competitiveness of the firms. On the other hand, Palmer *et al*. (1995) argued that strict environmental regulations will still lower the profits of firms even though they may adopt new technologies. With the pollution tax as the major environmental regulatory measures, Simpson and Bradford (1996) questioned whether more stringent environmental regulation will induce the competitive advantage as a practical policy recommendation. Jaffe *et al*. (1995) claimed that there are no sufficient evidences to support the argument of either side.

A government may adopt different environmental regulation means, such as emission standards, emissions charges and tradable pollution permit. Among them, tradable pollution permit was suggested by Pigou (1932), Dales (1968) and Barnett (1980). This method was adopted in the U.S. "Clean Air Act" and its amendments. Since 1990, in particular, it has brought remarkable economic and social benefits in control of the total sulfur dioxide emissions. This market oriented approach ensures that pollution permit have been effectively allocated between the polluters. The government can reduce pollution by issuing permits to firms and allowing them to be traded and transferred through market, so that an effective incentive mechanism will be formed to encourage firms to improve technology and reduce emissions. As a result, a firm aiming at maximizing profit would set pollution control such that the marginal cost of reducing pollution equals to permit market price. Hence, low-cost companies would sell pollution permits, while high-cost companies would buy pollution permits. Therefore, the permit trading system ensures the effectiveness of pollution reduction. And waste discharge permit trading has become a common international pollution control means. There are two main ways in trading emission permits. One is to provide for a limit (cap-and-trade) permit trading of emission rights; ie., the government allows total pollution emissions and a firm can transfer the remainder of the pollution permit to other firms. The other is to provide a baseline (baseline-and-credit) permit trading of emission rights, which means that the government allows the ratio of pollution emissions (Buckley *et al*., 2005). If the proportion

of a firm's pollution permit standard is lower than that set by the government, the firm may receive the credit of emission rights that can be for its own use or transferred to other firms in market.

Ulph (1996) discussed the pollution standards and tax situation adopted by the government, and compared the efficiency of two types of environmental regulation. With the upper limit (cap-and-trade) permit trading of emission rights as the primary means of environmental regulation, Alpay (2001) investigated how environmental regulations and international competitiveness are related. It is worth noting that the baseline-and-credit trading of emissions permits based on the relative standard provisions is different from the establishment of absolute standards in the pollution permit on the basis of the transaction. In the former case, the total emissions are no longer a fixed level; instead, they may vary with the output levels. What is more, firms can transfer the remaining pollution permits to each other. As more and more countries started to adopt this transferable licensing system in regulating pollution emissions, this paper also employs the base-line trading system of emission permits as the main instrument of government regulation to discuss the relationship between environmental regulation and international competitiveness. We find that the traditional views and the revisionist views are not irreconcilable in theory; the real issue is not simply 'what' is correct, but 'when' one or the other is correct. With a Cournot quantity model in an international environment, this paper examines the equilibrium output level and profit of a firm under the environmental regulation to show how environmental regulation may affect the international competitiveness of the firm.

According to Jenkins (1998), international competitiveness can be divided into three levels: firms, industries and countries. Our study is mainly focused on the comparison of international competitiveness at the level of firms. Many indicators are used to measure the international competitiveness of a firm. The two most commonly used measures are the market share and the profitability; the former reveals how popular the product is in the market, while the latter reflects how healthy the company is in management and operation.

2. Model and analysis

2.1 Model

There are two countries, N and S, and two firms, each located in one of the two countries. Both firms produce an identical product and

sell it in both home and foreign markets without transportation cost. The inverse demand function for the product in country i ($i = N, S$) is given by $P_i = a - bQ_i (a < 0, b < 0)$, where P_i is the market price and, $Q_i = \sum_{j=N,S} q_{ji}$, where q_{ji} is the quantity of product produced by firm j and sold in country i. The marginal cost of production in both firms is a constant c, and the total cost of firm i is, $C_i = C_i(q_i) = c(q_{ii} + q_{ij})$, $i,j = N,S$ and $i \neq j$. We assume that two firms play a Cournot quantity game.

Our intention is to examine how the introduction of environmental regulations in one country would affect the international competitiveness of the firm in that country. For this purpose, we will compare the output and profit levels of the firm in country N with and without environmental regulations adopted in it.

2.2 The Case without Environmental Regulation Adopted: A Benchmark

Without an incentive mechanism set by the government in either country, neither firm is willing to take the initiative to reduce its own emissions standards. Hence, they do not need to pay anything for the pollution in production. Firm i ($i = N, S$) solves the following problem:

$$\max_{q_{ii}, q_{ij}} \pi_i = P_i q_{ii} + P_j q_{ij} - c(q_{ii} + q_{ij}) \ , \ i,j = N,S \text{ and } i \neq j \ .$$

The first-order conditions are $a - 2bq_{ii} - bq_{ji} - c = 0$ and $a - 2bq_{ij} - bq_{jj} - c = 0$.

And the resulting equilibrium quantities, prices and profits are obtained as follows:

$$q_{ii}^0 = q_{ij}^0 = \frac{a-c}{3b}, \quad q_i^0 = q_{ii}^0 + q_{ij}^0 = \frac{2(a-c)}{3b}, \ i,j = N,S \text{ and } i \neq j \quad (1)$$

$$P_i^0 = P_j^0 = \frac{a+2c}{3}, \text{ and } \pi_i^0 = \frac{2(a-c)^2}{9b}, \quad i,j = N,S \text{ and } i \neq j, \quad (2)$$

where superscript 0 indicates the equilibrium without environmental regulation. The symmetry with no environmental regulations set in either country implies that both firms' international competitiveness in this case is exactly equal, as measured by their equilibrium quantities and profits.

2.3 The Case when Country N Introduces the Environmental Regulation

With economic expansion, waste emissions will inevitably increase in production process. As a result, it will have an impact

on the ecological environment. Hence, if a government cares about the quality of their own environment, it would set environmental regulations to control the volume of pollution. Assume that the government of country N is really concerned about the quality of environment and that it sets an environment regulation by using the provisions of baseline (baseline-and-credit) of the emission rights trading system license. In order to compare the international competitiveness of the firm in country N, we continue to assume that the government of country S does not value environmental quality high enough and hence does not set any environmental regulations to reduce pollution.

In country N, it is assumed that the pollution level, E_N, is proportional to the output of production, q_N, $E_N = eq_N, e > 0$, where e is a coefficient of pollution. Furthermore, the firm can invest in R & D to reduce pollution emissions. Pollution reduction is given by $A_N = kq_N, 0 \le k < e$, k depends on the input of R&D investment. Hence, the firms' net pollution level becomes $E_N - A_N = (e-k)q_N$. The more R & D the firm invests, the greater volume of pollution can be reduced. It is, however, costly to conduct R&D. The cost of pollution reduction is $C_A = k^2/2$. The government carries out the environmental regulation by setting a pollution upper limit $\bar{e}$ so that the pollution permits of a firm equal to $\bar{E}_N = \bar{e}q_N$. Under the system of tradable emission rights, a polluter has a right to trade the emissions in the market. It is assumed that the market price of a pollution permit is T.

Note that the firm in country S has no restriction on pollution. Thus, firm S solves

$$\max_{q_{SS}, q_{SN}} \pi_N = P_S q_{SS} + P_N q_{SN} - c(q_{SS} + q_{SN})$$

and firm N has to follow the rule as set by the pollution regulation, and its objective is

$$\max_{q_{NN}, q_{SN}} \pi_N = P_N q_{NN} + P_S q_{NS} - c(q_{NN} + q_{NS}) - C_A - T(E_N - A_N - \bar{E}_N).$$

Here C_A is the R&D cost, and $T(E_N - A_N - \bar{E}_N)$ is the payment to purchase the pollution permit in case the net pollution level still exceeds the upper limit as set by the government. From the first-order conditions, we can solve for the equilibrium quantities, prices and R & D investment under the environmental regulation as follows:

$$q_{NN}^1 = q_{NS}^1 = \frac{a - c - 2T(e - k^* - e)}{3b} \tag{3}$$

$$q_{SS}^1 = q_{SN}^1 = \frac{a - c + T(e - k^* - \bar{e})}{3b} \tag{4}$$

$$P_N^1 = P_S^1 = \frac{(a+2c)+T(e-k^*-\bar{e})}{3} \tag{5}$$

$$k^* = T(q_{NN}^1 + q_{NS}^1) = \frac{2T[(a-c)-2T(e-\bar{e})]}{3b-4T^2} \tag{6}$$

where the superscript 1 indicates the equilibrium under environmental regulation adopted in country *N*. Based on the above equilibrium quantities and R&D investment, we now conduct comparative statics to examine how environment regulations affect the firm's incentive to conduct the R&D investment as well as its international competitiveness.

We first examine how k^* is affected by the pollution standard $\bar{e}$. From (6), we have $\partial k^*/\partial \bar{e} = 4T^2/(3b-4T^2)$. So, $\partial k^*/\partial \bar{e} < 0$ iff $3b < 4T^2$, or equivalently, $T > \sqrt{3b}/2$. Moreover, $k^* > 0$ iff $(3b-4T^2)\ [a-c-2T(e-\bar{e})] > 0$. It leads to the following:

Proposition 1 - Assume that country *N* introduces the environmental regulations[1].

(a) If $T > \sqrt{3b}/2$ and $e > \bar{e} + (a-c)/2T$, then $k^* > 0$ and $\partial k^*/\partial \bar{e} < 0$;
(b) If $T < \sqrt{3b}/2$ and $e < \bar{e} + (a-c)/2T$, then $k^* > 0$ and $\partial k^*/\partial \bar{e} > 0$.

Intuitively, part (a) in Proposition 1 states that if the market price for pollution permit is high enough and the current pollution situation is sufficiently severe relative to the pollution limit, then the firm will invest in R&D to reduce pollution. And a more stringent pollution limit may force the firm to invest more in R&D activities. In contrast, part (b) claims that if the market price for pollution permit is relatively low and the current pollution situation is not too bad relative to the pollution limit, then the firm will still invest in R&D to reduce pollution up to a certain level. And a more stringent pollution limit may discourage the firm from further conducting R&D. This is very interesting, and it can be interpreted by the feature of tradable baseline-and-credit regulation *per se*; if the pollution permit is relatively inexpensive, a more restrictive pollution standard may lead the firm to buy the permit rather than conduct more R&D because the marginal cost of reducing pollution is increasing.

Next, we examine how an introduction of environment regulations in country *N* would influence its firm's international competitiveness

[1] Note that $\bar{e}$ is specific pollution permit; the smaller its value is, the more stringent government environmental regulation is.

measured by its market share and profitability. Recall that equation (1) in section 2.2 gives the equilibrium level of output of firm N without the implementation of environmental regulations is $q_N^0 = q_{NN}^0 = q_{NS}^0$ $2(a-c)/3b$. Also, equation (3) shows that the equilibrium output level of firm N under the implementation of environmental regulation is $q_N^1 = q_{NN}^1 + q_{NS}^1 = [2(a-c) - 4T(e-k^*-\bar{e})]/2b$, while the total output of firm S is $q_S^1 = q_{SS}^1 + q_{SN}^1 = [2(a-c) + 2T(e-k^*-\bar{e})]/3b$. Therefore, we have

$$q_N^1 - q_N^0 = \frac{-4T(e-k^*-\bar{e})}{3b} = \frac{4T[2T(a-c) - 3b(e-\bar{e})]}{3b(3b-4T^2)}, \tag{7}$$

$$q_S^1 - q_S^0 = \frac{2T(e-k^*-\bar{e})}{3b} = \frac{-2T[2T(a-c) - 3b(e-\bar{e})]}{3b(3b-4T^2)}. \tag{8}$$

It implies from (7) and (8) that if $e > \bar{e} + 2T(a-c)/3b$, and $4T^2/3 > b$ or if $e < \bar{e} + 2T(a-c)/3b$ and $4T^2/3 < b$, then, $q_N^1 > q_N^0 = q_S^0 > q_S^1$. However, if $e > \bar{e} + 2T(a-c)/3b$ and $4T^2/3 < b$, or if $e < \bar{e} + 2T(a-c)/3b$ and $4T^2/3 > b$ then, $q_N^1 < q_N^0 = q_S^0 > q_S^1$. We summarize the above analysis in the following:

Proposition 2 - Assume that country N has introduced the environmental regulation while country S does not.

(a) If $e > \bar{e} + 2T(a-c)/3b$ and $T > \sqrt{3b}/2$, or if $e < \bar{e} + 2T(a-c)/3b$ and $T < \sqrt{3b}/2$, then, $q_N^1 > q_N^0 = q_S^0 > q_S^1$;

(b) If $e > \bar{e} + 2T(a-c)/3b$ and $T < \sqrt{3b}/2$, or if $e < \bar{e} + 2T(a-c)/3b$ and $T > \sqrt{3b}/2$, then, $q_N^1 < q_N^0 = q_S^0 < q_S^1$;

Intuitively, Proposition 2 shows that the implementation of environmental regulations in a country does not necessarily reduce the international competitiveness of a firm in that country. Rather, under certain conditions the implementation of environmental regulation in a country will help improve its firm's product market share. Part (a) of Proposition 2 gives two such conditions. The first condition is when the current pollution situation is severe relative to the standard set by the government and the market price of pollution permit is sufficiently high, and the second one is when the current pollution situation is not too severe under the government standard and the pollution permit is not too expensive. In either case, the implementation of environmental regulation in country N will actually help improve the market share of its firm. The driving force is the mechanism behind the tradable base-and-credit system. From Proposition 1, note that the same conditions given in part (a) of Proposition 2 would also induce the firm to conduct R&D investment. Under these conditions, hence, the environmental regulation *per se*

plays a role of strategic commitment that the firm will 'play tough' like a 'top dog' (Fudenburg and Tirole, 1984; and Tirole, 1988) in the product market. This is because an increase in output level will reduce the average cost of technological innovation so that the firm has an incentive to increase production so as to benefit in the emissions trading market. On the other hand, if the market price of pollution permit is relatively inexpensive and the current pollutant emission situation is not very severe compared with the pollution standard, the firm may increase its output level without worrying too much about the pollution, as it is not too costly to further reduce the pollution coefficient to meet the standard, and to simply purchase some pollution permits in the market, if necessary. Therefore, even if country S has not established any restrictions on the pollution for its domestic business, the implementation of environmental regulations in country N in the form of tradable baseline-and-credit system may actually provide its firm with an incentive to carry out technological innovation or purchase pollution permit. It in turn can improve their market share in the product market (Bulow *et al*., 1985).

In some other cases, however, the implementation of environmental regulations in country N may indeed weaken its firm's competitiveness. This situation can happen, for example, if $T > \sqrt{3b}/2$ and $e - 2T(a-c)/3b < \bar{e} < e - (a-c)/2T$. Note in Proposition 1, $\bar{e} < e - (a-c)/2T$ implies that the firm would adopt the technological innovation. Also, from Proposition 2, $e - 2T(a-c)/3b < \bar{e}$ implies $q_N^1 - q_N^0 < 0$. It means the market share will fall, though the environmental standards may induce the firm to take technological innovation ($k^* > 0$).

Next, we continue to analyze the effect of implementation of environmental regulations on the profitability of the firms – the other aspect of the international competitiveness. From equation (2) in section 2.2, we can see the profit of firm N without the environmental regulations is $\pi_N^0 = \dfrac{2(a-c)^2}{9b}$. With the implementation of environmental regulations, its profit becomes:

$$\pi_N^1 = \frac{2[(a-c) - 2T(e - k^* - \bar{e})]^2}{9b} - \frac{(k^*)^2}{2} \tag{9}$$

Thus,
$$\pi_N^1 - \pi_N^0 = M[A(e-\bar{e})^2 + B(e-\bar{e}) + C] \tag{10}$$

where $M = 2T/[9b(3b - 4T^2)^2]$, $A = 36Tb(b - T^2)$, $B = 36b(T^2 - b)(a-c)$, and $C = T(15b - 16T^2)(a-c)^2$.

We now discuss the sign of $\pi_N^1-\pi_N^0$. Since $M>0$, $\pi_N^1-\pi_N^0$ has the same sign as $A(e-\overline{e})^2+B(e-\overline{e})+C$, in terms of equation (10). Let's consider the following possible cases:

(i) If $A=0$, then $b=T^2$. It implies that $B=0$ and $C=-Tb(a\text{-}c)^2<0$. Hence, $\pi_N^1-\pi_N^0<0$.

(ii) If $A\neq 0$, then $A(e-\overline{e})^2+B(e-\overline{e})+C$ represents a parabola with the vertex at $(-\frac{B}{2A},\frac{4AC-B^2}{4A}) =(\frac{a-c}{2T}, -\frac{(a-c)^2(3b-4T^2)^2}{T})$, which is in the fourth quadrant[2]. Then, we have the following two subcases:

(iia) $A>0$ (ie., $b>T^2$). The parabola is concave upward. Denote its two crossing points with the x-axis (for e) as m_1 and m_2 (with $m_1<m_2$). If $m_1<(e-\overline{e})<m_2$, ie., $e-m_2<\overline{e}<e-m_1$, then $\pi_N^1-\pi_N^0<0$; if $(e-\overline{e})<m_1$ or $(e-\overline{e})>m_2$; ie., $\overline{e}>e-m_1$ or $\overline{e}<e-m_2$, then $\pi_N^1-\pi_N^0>0$.

(iib) $A<0$ (ie., $b < T^2$). The whole parabola is concave downward and hence below the x-axis. Therefore, $\pi_N^1-\pi_N^0<0$.

The above discussion leads us to the following.

Proposition 3 - Assume that only country N sets environmental regulations.

(a) If $T<\sqrt{b}$, the implementation of environmental regulations would improve firm N's profit when $\overline{e}<e-m_2$ or $\overline{e}>e-m_1$; but it would lower its profit when $e-m_2<\overline{e}<\mathrm{e}-m_1$.

(b) If $T>\sqrt{b}$, the implementation of environmental regulations would cut firm N's profit.

Intuitively, Proposition 3 shows that the implementation of environmental regulation can affect the profitability of firm N, but not always negatively. Specifically, if the market price of pollution permit is relatively inexpensive, then it may actually improve the firm's profit when the current emission situation is either very high or very low relative to the standard as set by the regulator. Otherwise, in particular, if the market price of pollution permit is high enough, then the regulation would lower the firm's profit.

Finally, we compare the relative international competitiveness

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[2] To make the discussione meaningful, we have assumed that $b\neq 4T^2/3$. Therefore, a parabola vertex will not be on X-axis, which indicates $b>T^2$ and does not include the circumstances $b=4T^2/3$.

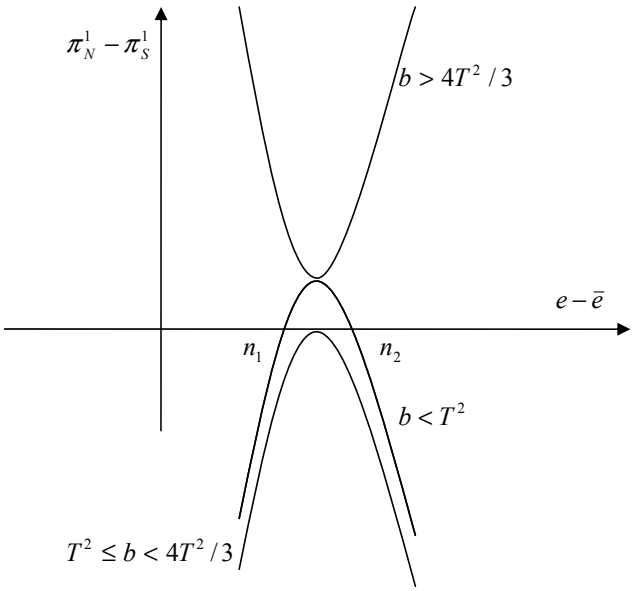
between firm N and S when country N introduces the environmental regulations. From equations (1) and (2), when the government of country N implements the environmental regulations on its firm, the equilibrium profits of firm S and N are given as follow:

$$\pi_S^1 = \frac{2[(a-c)+T(e-k^*-\bar{e})]^2}{9b}$$

$$\pi_N^1 = \frac{2[(a-c)-2T(e-k^*-\bar{e})]^2}{9b} - \frac{(k^*)^2}{2}$$

Hence, we have $\pi_N^1 - \pi_S^1 = N[G(e-\bar{e})^2 + H(e-\bar{e}) + I]$, where $N = 2T/[3b(3b-4T^2)^2]$, $G = 3Tb(3b-4T^2)$, $H = 6b(4T^2-3b)(a-c)$, and $I = 3T(3b-4T^2)(a-c)^2$.

FIGURE 1 - *Parameter Configuration*



Since $N > 0$, we have $sign(\pi_N^1 - \pi_S^1) = sign(G(e-\bar{e})^2 + H(e-\bar{e}) + I)$. Note that $G(e-\bar{e})^2 + H(e-\bar{e}) + I$ represents a quadratic function in a parabola with the vertex at $(\frac{a-c}{T}, -\frac{3(3b-4T^2)(T^2-b)(a-c)^2}{T})$, which is in the first or the fourth quadrant (see Figure 2), depending on parameter configurations.

Case (1): $T < \sqrt{3b}/2$. The parabola is open upward and the vertex is in the first quadrant. Thus, $\pi_N^1 - \pi_S^1 > 0$.

Case (2): $\sqrt{3b}/2 < T \leq \sqrt{b}$. The parabola is open downward and the vertex lies in the first quadrant vertex or on the X-axis. Then, $\pi_N^1 - \pi_S^1 \leq 0$.

Case (3): $T > \sqrt{b}$. The parabola is open downward and the vertex of the parabola lies in the first quadrant. In this case, the parabola crosses the x-axis at two intersection points n_1 and n_2. Let $n_1 < n_2$. Then, if $n_1 < (e - \overline{e}) < n_2$, i.e., $e - n_2 < \overline{e} < e - n_1$, we have $\pi_N^1 - \pi_S^1 > 0$. We summarize the above analysis in the following:

Proposition 4 - With the implementation of environmental regulation in country N but not in country S, firm N may not necessarily be disadvantageous in profit compared with firm S. Specifically:

(a) If the market permission price T is sufficiently low (lower than $\sqrt{3b}/2$), then the profit of firm N will be higher than that of firm S;

(b) If the market permission price T is in an intermediate range (i.e., $\sqrt{3b}/2 < T \leq \sqrt{b}$), then the profit of firm N will not be higher than that of firms S;

(c) If the market permission price T is very high (higher than $\sqrt{b}$), then the profit of firm N may be still higher than that of firm S, provided that the strict degree of environmental regulations lies in a certain range of ($e - n_2 < \overline{e} < e - n_1$).

Proposition 4 shows the profitability of firm N under the government implemented environmental regulations in country N. From Propositions 1-3, we can see that if permission price T is low enough, implementation of environmental regulations will actually promote enterprises innovation and enhance the firm's international competitiveness as measured by market share and profit.

3. Conclusions

In the past few decades, many (developed) countries have adopted international environmental regulations to reduce pollution and improve environmental quality. Generally speaking, a government may have two means of environmental regulations; the first is an administrative mean characterized by command control, and the second uses market-based economic instruments. Pollution permit trading system acts as an important economic instrument. It enables firms to truly become the major player in pollution control, and to

make a choice to conduct their own emissions. Therefore, choosing a proper environmental regulation incentive scheme has an important impact on the level of the international competitiveness of enterprises.

In this paper, we study the case in which only one country carries out environmental regulatory system while the other country does not, attempting to explore whether a country's environmental regulation will reduce its firm's international competitiveness with the introduction of emissions permit trading system. Technological innovation factors of firms are also taken into account. Both traditional view and the amended view are formed endogenously in a unified model, depending on the parameter configurations. The range of market price of emission permission and the regulated environmental standard play a crucial role in determining how regulation would influence the international competitiveness of the firm under regulation.

The main results have some interesting policy implications: first, if it incorporates the factor of firm's innovation, environmental regulations may improve the international competitiveness. It thus refutes, at least partially, the traditional view that implementation of environmental regulation in a country would always reduce the international competitiveness of its firms. Second, research on how environmental regulations and the international competitiveness are related also has important policy implications for developing countries. International competitiveness and environmental quality are an important component for the society. A government should take into account the need of the society as well as the market demand when choosing appropriate means of environmental regulation and environmental standards so as to achieve international competitiveness of firms and environmental protection in an integrated way.

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ABSTRACT

This paper develops a Cournot model to study how environmental regulatory policies affect the international competitiveness of firms. The tradable baseline-and-credit emission permit is employed as the primary means of environmental regulation. It provides a theoretical support for the government environmental regulatory policies.

Keywords: Environmental Regulation, Innovation, Oligopoly, International Competitiveness

JEL Classification: D43, F18, L51, O31

RIASSUNTO

Regolazione ambientale, innovazioni d'impresa e competitività internazionale

Questo studio sviluppa un modello di Cournot per analizzare come le politiche di regolamentazione ambientale influenzino la competitività internazionale delle imprese. Il sistema dei diritti di emissione negoziabili viene impiegato come principale mezzo di regolamentazione ambientale e si fornisce un supporto teorico per l'applicazione di tali regolamentazioni.