Profitable Strategic Environmental Corporate Social Responsibility*

Kosuke Hirose†

Graduate School of Economics, The University of Tokyo

Sang-Ho Lee‡

College of Business Administration, Chonnam National University

and

Toshihiro Matsumura§

Institute of Social Science, The University of Tokyo

May 26, 2015

Abstract

We investigate whether environmental corporate social responsibility (ECSR) is profitable for firms under price competition. We show that firms voluntary adopt ECSR when they face Bertrand competition. In Stackelberg model, although the price leader does not adopt ESCR, the price follower adopts it, which increases both firms' profits. We also find that the first-mover has advantage, which is in contrast to the second-mover advantage in standard price competition models.

JEL classification numbers: H42, H44, L13, L32

Keywords: corporate social responsibility, implicit carbon price, first-mover advantage. collusion

*This work was supported by the National Research Foundation of Korea Grant (NRF-2014S1A2A2028188), Murata Science Foundation, and JSPS KAKENHI (15k03347).

† Correspondence author: Kosuke Hirose, Graduate School of Economics, The University of Tokyo, 7-3-1, Hongo, Bunkyo-ku, Tokyo, 113-0033, Japan. E-mail: 2223389948@mail.ecc.u-tokyo.ac.jp

‡E-mail:sangho@chonnam.ac.kr

§E-mail:matusmur@iss.u-tokyo.ac.jp

1 Introduction

Environmental corporate social responsibility (ECSR) has received increasing attention from both national and social science researchers. Especially, economic researchers have intensively discussed this problem (Liu et al, 2015) because many listed firms announce that they are highly concerned with ECSR (KPMG, 2013). CDP (2013) reported that some major companies such as ExxonMobil, Walt Disney, Walmart, and Microsoft, use internal (implicit) carbon price as incentive and strategic planning tool, although their internal carbon prices are quite different among companies, from 6 to 60 dollars per ton.

Why do the firms adopt ECSR although it is costly? One plausible answer is adopting it is profitable for firms. Some empirical works suggested that the financial performance of the firms that are believed to be highly concerned with ECSR is better.[1]

Why do these firms earn more? One possible answer is adopting ECSR increases the firms' demand and thus increases their profits, and many works in this field accepted this assumption (See Liu et al (2015) and works cited by them).

In this study, we demonstrate that adopting ECSR is profitable for firms even if it does not increases their demand. Firms are assumed to partially recognizes the negative externality as their costs and maximize the modified profits, and the weight of ECSR in their payoffs is determined by profit-maximizing owners.

We discuss two duopoly models under price competition. In both models, owners of firms simultaneously chooses their weight of ECSR in firms' payoffs in the first stage, and then firms face price competition. First, we investigate Bertrand competition. We find that both firms choose a strictly positive weight of ECSR, and resulting their profits are larger than that without ECSR.

Next, we investigate Stackelberg competition. We find that although the price leader chooses zero weight (i.e., it does not adopt ECSR), the price follower choose positive weight of ECSR.

[1] See Kitzmueller and Shimshack (2012). Goering(2014) showed that CSR can increase industry profit by considering a bilateral monopoly where a downstream firm is concerned with both its own profit and consumer surplus.

We find that although the follower obtains higher profit than that without ESCR, the leader also obtains higher profit due to the rival's ESCR, and the leader obtains higher profit than the follower. This result is in sharp contrast to the result of the second-mover advantage under price competition.

2 The Model

We assume a standard differentiated duopoly with linear demand (Dixit, 1979). The quasilinear utility function of the representative consumer is $U(q_1, q_2) = \alpha(q_1 + q_2) - \beta(q_1^2 + 2\delta q_1 q_2 + q_2^2)/2 + y$, where y is the consumption of an outside good that is provided competitively with a unit price. Parameters α and β are positive constants, and $\delta \in (0, 1)$ represents the degree of product differentiation: a smaller δ indicates a larger degree of product differentiation.

Firms 1 and 2 produce differentiated commodities for which the inverse demand function is given by $p_i = \alpha - \beta q_i - \beta\delta q_j$ $(i = 1, 2,\ i \neq j)$, where p_i and q_i are firm i's price and quantity, respectively. The common marginal production cost is constant and it is normalized as zero. Firm i's emission that produces negative externality is ηq_i. Its payoff is $U_i = \pi_i - \theta_i \eta q_i$, where $\theta_i (\geq 0)$ is internal emission price and represents the degree of ECSR, and it is determined by the owner of firm i. The owner i's payoff is π_i.

The game runs as follows. In the first stage, the owner of firm i chooses θ_i independently. In the second stage, firms face price competition, either Bertrand or Stackelberg competition.

3 Bertrand Competition

We discuss the second-stage price competition. Suppose that firms choose their prices independently, given θ_1 and θ_2 (Bertrand competition). Without loss of generality, we assume that $\theta_1 \leq \theta_2$. The first-order condition is

$$\frac{\partial U_i}{\partial p_i} = \frac{\alpha(1-\delta) + \eta\theta_i - 2p_i + \delta p_j}{\beta(1-\delta^2)} = 0. \tag{1}$$

The reaction function of each firm is

$$R_i(p_j) = \frac{\alpha(1-\delta) + \eta\theta_i + \delta p_j}{2}. \tag{2}$$

The Bertrand equilibrium is

$$\begin{aligned} p_i &= \frac{\alpha(2-\delta-\delta^2) + 2\eta\theta_i + \delta\eta\theta_j}{4-\delta^2}, & (3)\\ \pi_i &= \frac{\big(\alpha(-2+\delta+\delta^2) - \eta(2\theta_i + \delta\theta_j)\big)\big(\alpha(-2+\delta+\delta^2) - \eta(\theta_i(-2+\delta^2) + \delta\theta_j)\big)}{\beta(-4+\delta^2)^2(1-\delta^2)}. & (4) \end{aligned}$$

We now discuss the first-stage actions. The owner of firm i chooses θ_i. The first-order condition is

$$\frac{\partial \pi_i}{\partial \theta_i} = \frac{-\eta(\delta^2(\alpha(-2+\delta+\delta^2) - \eta\delta\theta_j) + 4\eta(-2+\delta^2)\theta_i)}{\beta(-4+\delta^2)^2(-1+\delta^2)} = 0. \tag{5}$$

The reaction function of each owner is

$$B_i(\theta_j) = \frac{\delta^2(\alpha(-2+\delta+\delta^2) - \eta\delta\theta_j)}{4\eta(-2+\delta^2)}. \tag{6}$$

The equilibrium θ_i is

$$\theta_1 = \theta_2 = \frac{\alpha(-1+\delta)\delta^2}{\eta(-4+2\delta+\delta^2)^2} > 0. \tag{7}$$

The resulting profit is

$$\pi_1 = \pi_2 = \frac{2\alpha^2(2-2\delta-\delta^2+\delta^3)}{\beta(1+\delta)(-4+2\delta+\delta)^2} \tag{8}$$

This is strictly larger than the profit when $\theta_1 = \theta_2 = 0$. This leads to the following proposition.

Proposition 1 *Under Bertrand competition, both firms adopt ESCR and it increases the firms' profits.*

Both firm voluntary adopt ECSR that increases their (implicit) marginal costs in production. An increase in the cost raises the equilibrium prices, resulting in an increase in the industry profits.

In the above discussion, each firm independently chooses θ to maximize its own profit. If firms collude in the first stage given the non-cooperative behavior in the second stage, they cooperatively choose a higher θ than that in equation (8).[2] This suggests that economic associations have a stronger incentive to encourage firms to adopt ECSR than that each firm has.[3]

4 Stackelberg Competition

First, we discuss the second-stage price competition. Suppose that firm 1 chooses its price and then firm 2 chooses its price. Firm 2 chooses $p_2 = R_2(p_1)$. Firm 1 maximizes $\pi_1(p_1, R_2(p_1)) - \theta_1 \eta q_1(p_1, R_2(p_1))$ with respect to p_1.

The first-order condition is

$$\frac{\alpha(-2+\delta+\delta^2)+\eta(\delta^2-2)\theta_1-\eta\delta\theta_2+(4-2\delta^2)p_1}{2\beta(-1+\delta^2)} = 0. \tag{9}$$

The Stackelberg equilibrium is

$$\begin{aligned}
p_1 &= \frac{\alpha(-2+\delta+\delta^2)+\eta(-2+\delta^2)\theta_1-\eta\delta\theta_2}{2(-2+\delta^2)} \\
p_2 &= \frac{1}{2}\left(\alpha(1-\delta)+\frac{\delta(\alpha(-2+\delta+\delta^2)+\eta(-2+\delta^2)\theta_1-\eta\delta\theta_2)}{2(-2+\delta^2)}\right), \\
\pi_1 &= \frac{(\alpha(-2+\delta+\delta^2)+\eta((-2+\delta^2)\theta_1-\delta\theta_2))(\alpha(-2+\delta+\delta^2)-\eta((-2+\delta^2)\theta_1+\delta\theta_2)))}{8\beta(-2+\delta^2)(-1+\delta^2)}, \\
\pi_2 &= \frac{H}{16\beta(-2+\delta^2)^2(1-\delta^2)},
\end{aligned} \tag{10}$$

where $H := \alpha(4-2\delta-3\delta^2+\delta^3)+\eta(\delta(2-\delta^2)\theta_1+(3\delta^2-4)\theta_2))(\alpha(4-2\delta-3\delta^2+\delta^3)-\eta(\delta(-2+\delta^2)\theta_1+(\delta^2-4)\theta_2)$.

We now discuss the first-stage actions.[4] The owner of firm i chooses θ_i. The first-order condition

[2] If firms collude in choosing prices, it is apparently against anti-trust legislations. However, it is not obvious that cooperation in choosing θ is against them.

[3] For example, many Japanese economic associations such as Japan Association of Corporate Executives, the Japan Business Federation, the Japan Iron and Steel Federation, the Federation of Electric Power Companies of Japan emphasize ECSR in their reports and websites.

[4] In this study, we assume that firms choose θ simultaneously. Our results hold true if firms choose *theta* sequentially.

are

$$\frac{\partial \pi_1}{\partial \theta_1} = \frac{\eta^2(2-\delta^2)\theta_1}{4\beta(-1+\delta^2)} = 0, \tag{11}$$

$$\frac{\partial \pi_2}{\partial \theta_2} = \frac{\eta(\delta^2(\alpha(4-2\delta-3\delta^2+\delta^3)-\eta\delta(-2+\delta^2)\theta_1)-\eta(16-16\delta^2+3\delta^4)\theta_2)}{8\beta(-2+\delta^2)^2(1-\delta)} = 0. \tag{12}$$

The equilibrium θ_i is

$$\theta_1 = 0,\ \theta_2 = \frac{(-1+\delta)\delta^2\alpha(\delta^2-2\delta-4)}{\eta(16-16\delta^2+3\delta^4)} > 0. \tag{13}$$

The resulting profit is

$$\pi_1 = \frac{\alpha^2(-1+\delta)(-2+\delta^2)(-8-4\delta+4\delta^2+\delta^3)^2}{2\beta(1+\delta)(4-3\delta^2)(-4+3\delta^2)} > \frac{\alpha^2(-1+\delta)(-4-2\delta+\delta^2)^2}{4\beta(1+\delta)(4-\delta^2)(-4+3\delta^3)} = \pi_2 \tag{14}$$

π_2 is strictly larger than the profit when $\theta_1 = \theta_2 = 0$. This leads to the following proposition.

Proposition 2 *In the Stackelberg model, only the follower adopts ESCR and it increases both firms' profits. The leader earns the larger profit than the follower.*

The price leader can directly commit to the higher price before the follower chooses the price, and thus, it need not indirectly commit to the higher price by choosing a positive θ. On the contrary, the follower has an incentive to commit to the higher price by adopting a positive θ because it *ex postly* has an incentive to lower the price given the leader's price.

If firms can collude in the first stage given the price competition in the second stage and maximize their joint profits, we can show that both the leader and the follower adopt positive θ. Thus, it might be misleading to emphasize the result that the leader does not adopt ECSR too much.

Finally, we discuss what happens if the timing in the second-stage competition is endogenized. If we adopt the observable delay game formulated by Hamilton and Slutsky (1990) in the price competition stage,[5] we can show that the Stackelberg competition that is discussed in this section

[5] The observable delay game is the most popular model among endogenous timing games and has been adopted extensively in various contexts. See Matsumura and Ogawa (2014).

appears in equilibrium. The firm that chooses a lower θ (and thus, a lower cost firm) takes price leadership and obtains a higher profit.[6]

5 Concluding Remarks

In this study, we demonstrate that firms voluntary adopt ECSR for profit purpose. An increase in the cost raises the price, resulting in an increase of industry profits. Therefore, ECSR can yield collusive pricing, and the loss of too high price can reduce welfare, although it reduces the total emission.

In this study, we neglect environmental policies such as emission tax, tradable permits, and emission standard. ECSR may reduce the environmental tax or relax the environmental regulation, which further increases the industry profits. Introducing the government as an active player that chooses environmental policies and investigating the relationship between these policies and ECSR remains for future research.

[6] Ono(1978) first pointed out that the firm with a lower cost becomes the price leader.

References

CDP, 2013. Use of internal carbon price by companies as incentive and strategic planning tool: A review of findings from CDP 2013 disclosure.

Dixit, A. K. 1979. A model of duopoly suggesting a theory of entry barriers. Bell Journal of Economics 10(1), 20–32.

Goering, G. E. 2014. The profit-maximizing case for corporate social responsibility in a bilateral monopoly. Managerial and Decision Economics 35, 493–499.

Liu, C.-C., Wang, L.F.S., Lee, S.-H. 2015. Strategic environmental corporate social responsibility in a differentiated duopoly market. Economics Letters 129,108–111.

Hamilton, J. H., Slutsky, S. M. 1990. Endogenous timing in duopoly games: Stackelberg or Cournot equilibria. Games and Economic Behavior 2(1), 29–46.

Kitzmueller, M., Shimshack, J. 2012. Economic perspectives on corporate social responsibility. Journal of Economic Literature 50(1), 51–84.

KPMG, 2013. International Survey of Corporate Responsibility Reporting. KPMG international.

Matsumura, T., Ogawa, A. 2014. Corporate social responsibility or payoff asymmetry?:a study of endogenous timing game. Southern Economic Journal 81(2), 457–473.

Ono, Y. 1978. The equilibrium of duopoly in a market of homogeneous goods. Economica 45(179), 287–295.