Research Article

Certification of Environmental Corporate Social Responsibility Activities in Differentiated Duopoly Market

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In this paper, by environmental Nongovernmental Organizations certification we research corporate social responsibility in the impacts of competition structures on corporate incentives. The research explained that, to induce firms to adopt certified environmental corporate social responsibility, the certifier will set a standard lower than the optimal one. The environmental certification corporate social standard equal to that in Cournot competition and Bertrand competition, but Bertrand competition structure will make the firm get more benefits than Cournot competition. In addition, the research also shows that firms and consumers all will get benefit from environmental corporate social responsibility.

1. Introduction

Corporate social responsibility is a concept where companies take account of both social and environmental concerns during economic activities and with the participation of interest related subject on voluntary basis. (European Commission, 2001, has recently received considerable publicity, leading many companies to account for the social consequences of their activities. (Since 1993, KPMG’s triannual survey suggests steady growth in the number of firms with a CSR strategy, including well-defined objectives, as well as in the number of firms certifying their CSR activities. KPMG (2008) reports that 80% of the top 250 companies of the Global Fortune 500 issue a certified CSR report compared with 52% in 2005.) Existing evidence suggests that consumers respond positively to the firms’ efforts for social responsibility. (Widespread evidence from manufacturing industries (Elfenbein and McManus 2007; Hiscox and Smyth 2006), tourism services (Blanco, Ray-Maquieira, and Lozano 2009), and agricultural production in Latin America (Raynolds, Murray, and Taylor 2004; Plastina and Arnould 2007) and African countries (Becchetti and Costantino 2006) suggests that consumers express willingness to pay a premium for goods and services produced by socially responsible firms.) Fifty-nine percent of the world’s largest companies (G250) invest in external assurance stakeholders to provide a reputation for corporate social responsibility [1].) The above-mentioned discussion raises important issues for corporate strategy and public policy. Yet, as Benabou and Tirole [2] state, “despite its growing importance, little is known about the economics of individual and corporate social responsibility.”

Corporate social responsibility through the company to invest in production technology and business processes, beyond the legal requirements, is conducive to the company’s stakeholders [3, 4]. Corporate social responsibility activities are difficult, if not impossible, to be searched or consumed by consumers. In this context, we consider the social responsibility attributes that are attached to the product through the company’s corporate social responsibility activities that are classified as a good credit. Therefore, there is a need for a corporate social responsibility information disclosure mechanism, a reliable signal to consumers’ efforts. A certain standard for the realization of a company by third party certification [5, 6] serves as such a mechanism.
From the perspective of corporate social responsibility is whether corporate social responsibility should exist [7–11] why it exists and how it affects the economy [2, 12–14]. Because of the function of document of corporate social responsibility activities, the recent literature, such as Manasakis et al., emphasizes the importance of a credible information disclosure mechanism for a sustainable corporate social responsibility related good market [7, 15]. Overall, they found that corporate social responsibility activity with a credible information disclosure system benefits consumers and businesses should be encouraged. Manasakis et al. show that corporate social responsibility is influenced by the company’s promotion, market, and social participation [15]. At the same time, the label certification bodies in the competition between the plight of strict standards and compliance companies have emerged. In particular, Manasakis et al. (2013) investigated the impact of the choice of certification bodies on the dynamics of corporate social responsibility activities and their relative market and social significance [15].

In this paper, we research Nongovernmental Organizations’ criteria with relation to beneficial market and the principles of corporate strategic incentives using the corporate social responsibility in alternative competitive structures. Vermeer and Michalko (2010) reported that Nongovernmental Organizations are the most common ecoklubers [16]. The Nongovernmental Organizations certification body sets the environmental corporate social responsibility standard and verifies the implementation of an enterprise maximizing net consumer surplus, which is defined as the total consumer surplus of the net company’s emissions caused by environmental destruction.

The positive impact of the research results in the identification of Nongovernmental Organizations in alternative competitive structures. The study also found that the certification agency will set an optimality criterion with environmental corporate social responsibility certification; standards of corporate social responsibility in Cournot competition are equal to the standards of corporate social responsibility in the Bertrand competition. However, compared with Cournot competition, Bertrand competition has more benefits for companies and adopting ECSR certification is beneficial for both companies and consumers.

This article is organized as follows. In Section 2, we model the certification of environmental corporate social responsibility activities. In Section 3, we discuss the equilibrium outcome with firms that have two situations, not adopting and adopting, about environmental corporate social responsibility in Cournot competition. In Section 4, we discuss the equilibrium outcome with firms that have two situations, not adopting and adopting, about environmental corporate social responsibility in Bertrand competition. In Section 5, we compare the environmental corporate social responsibility in Cournot competition and Bertrand competition.

2. The Model

We consider a competition between two firms (players), labeled by \( i = 1, 2 \). In particular, following Singh and Vives [17] and Manasakis et al. [7, 15], the utility function of a representative consumer is

\[
U(\beta) = (\alpha + e_1\beta s_1) x_1(\beta) + (\alpha + e_2\beta s_2) x_2(\beta) - \frac{1}{2} \left( x_1^2(\beta) + x_2^2(\beta) + 2\gamma x_1(\beta) x_2(\beta) \right),
\]

where \( x_i(\beta), (i = 1, 2) \) represents product \( i \)'s quantity bought by the \( \beta \)-type consumer and \( s_i \geq 0 \) is the level of environmental corporate social responsibility firm \( i \) undertakes \((i = 1, 2)\). The parameter \( \gamma \in (0, 1) \) represents the intensity of market competition between firms, when \( \gamma \) tends to 1, representing a more competitive market. The parameter \( \beta \in [0, 1] \) represents the consumer’s preference for firms’ environmental corporate social responsibility. Finally, \( \alpha \) measures quality in a vertical sense.

Because the credence feature of corporate social responsibility may result in a moral hazard problem, following Manasakis et al. [7], we consider a Nongovernmental Organization certifier, which seeks to maximize net consumer surplus and serves as a credible information disclosure mechanism of firms’ environmental corporate social responsibility. Particularly, it supposes that \( s \) is the lowest level of environmental corporate social responsibility certification. So, it has

\[
e_i = \begin{cases} 
0, & \text{if } s_i < s \text{ and firm } i \text{ does not receive a certificate}, \\
1, & \text{if } s_i \geq s \text{ and firm } i \text{ receives a certificate},
\end{cases} \quad i = 1, 2.
\]

Therefore, for any given \( \beta \) and \( s \), a representative consumer’s utility can be explained as

\[
U(\beta) = (\alpha + e_1\beta s_2) x_1(\beta) + (\alpha + e_2\beta s_2) x_2(\beta) - \frac{1}{2} \left( x_1^2(\beta) + x_2^2(\beta) + 2\gamma x_1(\beta) x_2(\beta) \right),
\]

Hence, \( \beta \) represents the increase of the \( \beta \)-type consumer’s willingness to pay for the firm’s good per unit of firm’s expected corporate social responsibility effort. We assume that \( \beta \) is distributed according to a cumulative distribution function \( F(\beta) \), with a density function \( f(\beta) \) and \( \beta \in [0, 1] \). The more socially conscious a consumer is, the higher is his \( \beta \). Then, \( \beta = \int_0^{\beta} f(\beta)d\beta \) is the average consumer type in the population, and \( \text{var}(\beta) = \int_0^1 (\beta - \overline{\beta})^2 f(\beta)d\beta \) is the degree of consumers’ heterogeneity. Maximization of \( U(\beta) \) with respect to \( x_i(\beta) \) gives the \( \beta \)-type consumer’s (inverse) demand functions:

\[
P_i = \alpha + e_i\beta_2 - x_i(\beta) - \gamma x_j(\beta), \quad i, j = 1, 2; \ i \neq j,
\]

where \( P_i \) represents the price of firm \( i \)'s product. By inverting (4), we obtain the \( \beta \)-type consumer’s demand function:

\[
x_i(\beta) = \frac{(1 - \gamma) \alpha + e_i\beta_2 - \gamma e_j\beta_2 - P_i + \gamma P_j}{1 - \gamma^2}, \quad i, j = 1, 2; \ i \neq j.
\]
The price of the composite good has been normalized to unity. By integrating (5) with respect to $\beta$, we get firm $i$’s demand function:

$$ q_i(P_i, P_j) = \int_0^1 x_i(\beta) f(\beta) d\beta $$

$$ = \frac{(1 - \gamma) \alpha + \beta(e_i - \gamma e_j) - P_i + \gamma P_j}{1 - \gamma}, $$

$$ i, j = 1, 2; \ i \neq j, $$

where $q_i \geq 0$ represents firm $i$’s output.

By inverting (6), firm $i$’s inverse demand function is

$$ P_i = \alpha + e_i \beta - q_i - \gamma q_j, \ i, j = 1, 2; \ i \neq j. $$

We assume that companies have same benefits and same production technology. $C_i(q_i, s_i) = c(1 + s_i)q_i$ represents firm $i$’s total cost function, where $0 < c < \alpha$. Firm unit cost $i$ increases along with corporate social responsibility level increasing at a certain rate. It is reasonable because when improving employee working condition, purchasing more expensive input from local suppliers, introducing “green” technology, it will cause negative influence for the firm’s production. Considering the influence of competition structure, standard of certification institution is checked by every firm. So, firm’s $i$ profit function is as follows:

$$ \pi_i = \begin{cases} (\alpha + \beta s - q_i - \gamma q_j)q_i - c(1 + s)q_i, & e_i = 1, \\ (\alpha - q_i - \gamma q_j)q_i - cq_i, & e_i = 0, \\ i, j = 1, 2; \ i \neq j. \end{cases} $$

Finally, given the linear specification of demand, net consumer surplus is given as

$$ NCS = \frac{q_1^2 + q_2^2 + 2\gamma q_1 q_2 - d(q_1 + q_2 - e_1 z - e_2 z)^2}{2}, $$

where $d > 0$ is the marginal environmental damage of firms’ emission.

The following sections explain environmental corporate social responsibility’s incentive strategies and market and social intentions. For the symmetry between firms, we focus on symmetric equilibrium only.

### 3. Cournot Competition

As a result, we end up with a standard firm $i$’s Cournot game with horizontally differentiated goods; according to how each enterprise chooses profit maximization principle, we have

$$ \pi_i = (\alpha - q_i - \gamma q_j)q_i - cq_i. $$

From the first-order condition, firm $i$’s reaction function is

$$ q_i = R_i^{CN}(q_j) = \frac{a - cq_j - c}{2}. $$

By symmetry, let superscript $CN$ denote firm $i$’s equilibrium output, price, and profits which are follows:

$$ q^{CN} = \frac{a - c}{2 + \gamma}, $$

$$ p^{CN} = c + \frac{a - c}{2 + \gamma}, $$

$$ \pi^{CN} = \left(\frac{a - c}{2 + \gamma}\right)^2, $$

$$ NCS^{CN} = \frac{(1 + \gamma - 2d)(a - c)^2}{(2 + \gamma)^2}. $$

Firms anticipate that their corporate social responsibility efforts have been credibly disclosed to consumers, via certification. We end up with a standard firm $i$’s Cournot game with horizontally differentiated goods; according to how each enterprise chooses profit maximization principle, we have

$$ \pi_i = (\alpha + \beta s - q_i - \gamma q_j)q_i - c(1 + s)q_i. $$

From the first-order condition, firm $i$’s reaction function is

$$ q_i = R_i^{CC}(q_j) = \frac{a + \beta s - \gamma q_j - c(1 + s)}{2}. $$

By symmetry, let superscript $CC$ denote firm $i$’s equilibrium output, price, and profits which are follows:

$$ q^{CC} = \frac{\alpha + \beta s - c(1 + s)}{2 + \gamma}, $$

$$ p^{CC} = c(1 + s) + \frac{\alpha + \beta s - c(1 + s)}{2 + \gamma}, $$

$$ \pi^{CC} = \frac{(a + \beta s - \gamma q_j - c(1 + s))^2}{(2 + \gamma)^2}. $$
\[
\pi_{CC} = \left(\frac{\alpha + \beta s - c (1 + s)}{2 + \gamma}\right)^2,
\]
\[
\text{NCS}_{CC} = \frac{(\alpha + \beta s - c (1 + s))^2 (1 + \gamma) - 2d [\alpha + \beta s - c (1 + s) - s (2 + \gamma)]^2}{(2 + \gamma)^2}.
\] (15)

When \((\alpha - c)/(2 + \gamma - \beta + c) \geq s\), we have \(q^{CC} \geq s\).

The following equation means firms’ equilibrium profits adopt or do not adopt environmental corporate social responsibility:

\[
\pi_{CC} - \pi_{CN} = \frac{2s (\alpha - c) (\beta - c) + (s (\beta - c))^2}{(2 + \gamma)^2}.
\] (16)

Thus, it can get the result that if \(s \leq 2(c - \alpha)/(\beta - c)\), so \(\pi_{CC} \geq \pi_{CN}\). Firm will choose adopting environmental corporate social responsibility and it will get benefits. Thus, if \(s \leq s^{CU} = 2(c - \alpha)/(\beta - c)\), firm will adopt environmental corporate social responsibility under Cournot competition; \(s^{CL}\) means that upper bound of firms will adopt environmental corporate social responsibility in Cournot competition.

Differentiating \(s^{CU}\) with respect to \(\beta\), we have

\[
d_{s^{CU}} = \frac{2 (\alpha - c) (\beta - c) + (s (\beta - c))^2}{(2 + \gamma)^2} > 0.
\] (17)

Thus, firm will undertake higher standard of environmental corporate social responsibility if consumers have more preference in more environmental corporate social responsibility.

Now considering the standard of the certifier in Cournot competition, it will have the maximal net consumer surplus by calculating \(d \text{NCS}_{CC}/ds = 0\), given as

\[
s^{CN} = \frac{(\alpha - c) [(1 + \gamma) (\beta - c) + 2d (c + 2 + \gamma - \beta)]}{2d (c + 2 + \gamma - \beta)^2 - (1 + \gamma) (c - \beta)^2}.
\] (18)

When \(d > (1 + \gamma) (c - \beta)^2 / 2 (c + 2 + \gamma - \beta)^2\), we have \(s^{CN} > 0\).

By comparing \(s^{CN}\) and \(s^{CLU}\), when \(d > (1 + \gamma) (c - \beta)^2 / 2 (c + 2 + \gamma - \beta)^2\), we have \(s^{CN} = s^{CLU}\), neither firm will adopt environmental corporate social responsibility which results in \(\text{NCS}_{CN} = (1 + \gamma - 2d) (\alpha - c)^2/(2 + \gamma)^2\). Thus, when certification is set as \(s = s^{CLU}\), both firms will adopt certified environmental corporate social responsibility which results in

\[
\text{NCS}_{CU} = \frac{(\alpha - c)^2 (1 + \gamma) (\beta - c)^2 - 2d (\alpha - c)^2 [(c - \beta) + 2 (2 + \gamma)]^2}{(2 + \gamma)^2 (\beta - c)^2}.
\] (19)

By comparing \(\text{NCS}_{CU}\) and \(\text{NCS}_{CN}\), it has

\[
\text{NCS}_{CU} - \text{NCS}_{CN} = \frac{4d (\alpha - c)^2 (2 + \gamma) [2 (2 + \gamma) + (c - \beta)]}{(2 + \gamma)^2 (\beta - c)^2} > 0.
\] (20)

**Proposition 1.** Thus, certifier needs to set the standard of environmental corporate social responsibility as \(s = s^{CLU}\) in Cournot competition.

### 4. Bertrand Competition

We end up with a standard firm \(i\)’s Bertrand game with horizontally differentiated goods; according to how each enterprise chooses profit maximization principle, we have

\[
\pi_i = (P_i - c) \frac{(1 - \gamma) \alpha - P_i + \gamma P_j}{1 - \gamma^2}.
\] (21)

From the first-order condition, firm \(i\)’s reaction function is

\[
P_i = R_{BC} \left( P_j \right) = \frac{a + \beta s - \gamma P_j - c (1 + s)}{2}.
\] (22)

By symmetry, let superscript \(\text{BN}\) denote firm \(i\)’s equilibrium output, price, and profits which are follows:

\[
q^\text{CN} = \frac{\alpha - c}{2 + \gamma}, \quad P^\text{CN} = \frac{c + \alpha - c}{2 + \gamma}, \quad \pi^\text{CN} = \left(\frac{\alpha - c}{2 + \gamma}\right)^2,
\]
\[
\text{NCS}^\text{CN} = \frac{(1 + \gamma - 2d) (\alpha - c)^2}{(2 + \gamma)^2}.
\] (23)

Firms anticipate that their corporate social responsibility efforts have been credibly disclosed to consumers, via certification. We end up with a standard firm \(i\)’s Bertrand competition horizontally differentiated goods; according to how each enterprise chooses profit maximization principle, we have

\[
\pi_i = (P_i - c) \frac{(1 - \gamma) \alpha - P_i + \gamma P_j}{1 - \gamma^2}.
\] (21)

From the first-order condition, firm \(i\)’s reaction function is

\[
P_i = R_{BC} \left( P_j \right) = \frac{a + \beta s - \gamma P_j - c (1 + s)}{2}.
\] (22)

Firms anticipate that their corporate social responsibility efforts have been credibly disclosed to consumers, via certification. We end up with a standard firm \(i\)’s Bertrand competition horizontally differentiated goods; according to how each enterprise chooses profit maximization principle, we have

\[
\pi_i = (P_i - c) \frac{(1 - \gamma) \alpha - P_i + \gamma P_j}{1 - \gamma^2}.
\] (21)

From the first-order condition, firm \(i\)’s reaction function is

\[
P_i = R_{BC} \left( P_j \right) = \frac{a + \beta s - \gamma P_j - c (1 + s)}{2}.
\] (22)
By symmetry, let superscript $BC$ denote firm $i$’s equilibrium output, price, and profits which are follows:

$$q^{BC} = \alpha + \frac{\beta s - c + c_s}{2 + \gamma - \gamma^2},$$

$$p^{BC} = \frac{(1 - \gamma)(\alpha + \frac{\beta s}{2} - c - c_s)}{2 - \gamma},$$

$$\pi^{BC} = \frac{(1 - \gamma)(\alpha + \frac{\beta s}{2} - c - c_s)^2}{2(1 + \gamma)},$$

$$NCS^{BC} = \frac{(\alpha + \frac{\beta s}{2} - c - c_s)^2}{2(1 + \gamma)} - \frac{2d(\alpha + \frac{\beta s}{2} - c - c_s)}{2 + \gamma - \gamma^2} - c(1 + s).$$

When $s \leq \frac{(\alpha - c)}{(2 + \gamma - \gamma^2 - \beta + c)}$, we have $q^{BC} \geq s$.

Comparing when firm chooses to adopt environmental corporate social responsibility or not to adopt environmental corporate social responsibility certification, the equilibrium outcome gives

$$\pi^{BC} - \pi^{BN} = \frac{(1 - \gamma)(\frac{s^2}{2}(c - \beta)^2 - 2s(\beta - c)(\alpha - c))}{(2 - \gamma)(1 + \gamma)}. \quad (27)$$

$$NCS^{RU} = \frac{(\alpha - c)^2(\beta - c)^2 + 2d(1 + \gamma)((\alpha - c)(\beta - c) + c)(\beta + c - 2\alpha)\left(2 + \gamma - \gamma^2\right)^2}{(2 + \gamma - \gamma^2)^2(\beta - c)^2}. \quad (30)$$

Comparing $NCS^{RU}$ and $NCS^{BN}$, it has

$$NCS^{RU} - NCS^{BN} = \frac{(\alpha - c)^2(\beta - c)^2\left(2d(\gamma) + 2d(1 + \gamma)((\alpha - c)(\beta - c) + c)(\beta + c - 2\alpha)(2 + \gamma - \gamma^2)^2}{(2 + \gamma - \gamma^2)^2(\beta - c)^2} > 0. \quad (31)$$

**Proposition 2.** So, it should set the environmental corporate social responsibility standard as $\bar{s} = \bar{s}^{RU}$ in Bertrand competition.

5. Comparison

Now we analyze the impact of environmental corporate social responsibility to the competition structure when adopting
Proposition 3. The certifier will set environmental corporate social responsibility standard in Cournot equal to in Bertrand competition.

Particularly, when adopting environmental corporate social responsibility, the cost of firm will increase. By comparing firms’ profits in Cournot and Bertrand competition, we find

$$\frac{d\pi^{CC}}{ds} - \frac{d\pi^{BC}}{ds} = 2(\beta - c) \left( a + \beta_2 - c - c_2 \right)$$

$$\cdot \frac{2(1 - y)^2 + y + y^2}{(2 + y)(2 - y)^2 (1 + y)} < 0.$$

As the marginal effect of environmental corporate social responsibility of Bertrand competition is much stronger than Cournot competition, firm which is in Bertrand competition is more willing to take environmental corporate social responsibility than that in Cournot competition.

### 6. Conclusions

The present paper has been motivated by the fact that firms’ corporate social responsibility activities are voluntary; products’ social responsibility attributes are unobservable by consumers, who perceive them as quality improvements and express a relatively increased willingness to pay for them. In this context, the present paper links individual and corporate social responsibility and studies firms’ owner’s incentives to commit to corporate social responsibility activities for a corporate governance context.

Our core argument is that, because consumers’ willingness to pay for corporate social responsibility products is relatively increased, each firm has incentives to strategically engage in such activities in order to obtain a competitive advantage in the market with Cournot competition and Bertrand competition. Two interesting directions for further research would be to investigate whether corporate social responsibility is a way for firms to achieve a competitive advantage via reducing the market and reputational risks that they face [18], as well as the case where successive corporate social responsibility efforts lead to an accumulation of reputation for firms and managers. The latter would link our research to the literature approaching corporate social responsibility from the resource-based theory point of view [19, 20].

We studied the competitive structure of the company’s incentive mechanism by enterprise environment social responsibility certification. The result is that, to induce firms to adopt certified environmental corporate social responsibility, the Nongovernmental Organization certifier will set the standard equal to the upper bound of environmental corporate social responsibility that firms are willing to adopt, both in Cournot and in Bertrand competition. The standard of environmental corporate social responsibility has equal effect in Cournot competition and Bertrand competition. With firms’ competition structure for Bertrand competition, it will have more benefits compared with Cournot competition.

### Competing Interests

The authors declare that they have no competing interests.

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