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Cooperation with a multiproduct corporation in a strategic managerial delegation

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Abstract

We consider an industry comprised of a multiproduct corporation that adopts CSR as a strategic managerial delegation and examine the profit-incentive to form a cooperative group. We find that competition is an equilibrium for any degree of substitutability and yields the highest CSR, which is increasing in the degree of substitutability. We also show that full cooperation is an equilibrium for lower substitutability but induces no CSR while partial cooperation with one uniplant firm is an equilibrium for higher substitutability but yields lower CSR than that under competition. Therefore, cooperation might reduce strategic CSR activities while competition will encourage higher CSR but yield lower industry profits.

Keywords: corporate social responsibility (CSR); consumer-friendly activities; full cooperation; partial cooperation; multiproduct corporation;

1. Introduction

In the last decades, business trend of corporate social responsibility (CSR) are expanding and the firm's engagement of CSR activities has become a global business practice.[1]As an academic response, the research debate on the motives pushing firms to engage in CSR activities has been also becoming increasingly prominent.[2] One of the challenging strategy issues is the possibility of cooperation among competing firms in the name of CSR. In fact, firm's CSR activities include investments in R&D, product design, advertising and the expansion of market shares, which provide other channels through firms' cooperation to create positive effects on the profits.

From the shareholder's viewpoint, CSR is regarded as an instrument of the firm's choice variables, which reflects management's incentive contract to engage in business strategy. For example, Starbucks increases its demand by

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[1]The global phenomenon that firms concern with CSR has been confirmed by various surveys, such as KPMG (2013, 2015) and UN Global Compact-Accenture CEO Study (2010, 2013).

[2]Benabou and Tirole (2010) and Baron (2001) provided recent developments in business economics and explained the benefits and costs of CSR. For more discussion, see Schreck (2011), Kitzmueller and Shimshack (2012), Crifo and Forget (2015), Planer-Friedrich and Sahm (2018), Wang et al. (2018) and Kim et al. (2019) among others. For the recent research in empirical and experiment fields, see also Flammer (2013, 2015), Chen et al. (2016) and Nishitani et al. (2017).

buying fair-trade coffee and tea from other organic firms and advertises heavily its consumer-friendliness. It enhances its reputation and image signaling concerns to increase firm value. Accordingly, from the profit-oriented motivations for adopting CSR behaviors, recent papers in the literature of managerial delegation have formulated the model of strategic choice of the degree of CSR and seek to explain firm's strategic profit-maximizing use of CSR.[3] They showed that the aim of maximizing profits can be a motive for the firm's engagement in CSR because the adoption of CSR may increase the firm's profits at the market equilibrium.

However, these works assumed that industry consists of a few firms which hold a single plant. In fact, in the real world many corporations comprise firms that produce various types of goods at various production plants.[4] Typical examples include consumer markets for automobiles, PCs, and air travel, as well as business markets for processed materials, computer servers, and various types of industrial machinery. These facts stress the importance of investigating the market performance with a multiproduct corporation that produces several differentiated goods. To our knowledge, however, studies to understand how multiproduct firms strategically utilize the CSR-initiatives are limited.

In this paper, we consider an industry comprised of a multiproduct corporation that adopts CSR as a strategic managerial delegation. The corporation is a consumer-friendly firm that owns two production plants, each of which produces differentiated substitutes and competes with a uniplant profit-maximizing firm in each market. We then examine the profit-incentive of a multiproduct corporation to form a cooperative group with other firms. In specific, we introduce our model of exogenously specified groups in which the groups pursue their own interests subject to incentive compatibility constraints. We then identify the necessary conditions of product substitutability when firms choose cooperative group formation endogenously.

Main findings in our analysis are as follows; (i) competition is an equilibrium for any degree of substitutability and yields the highest CSR effort, which is increasing in substitutability, (ii) full cooperation is an equilibrium for lower substitutability but induces no CSR, (iii) partial cooperation with one uniplant firm is an equilibrium for higher substitutability but yields lower CSR effort than that under competition, which is non-monotone in the substitutability, and (iv) cooperation between two uniplant firms is not an equilibrium. Therefore, cooperation might reduce strategic CSR activities while competition will encourage higher profit-oriented CSR but yield lower industry profits. This finding contributes to the understanding of the role of profit-oriented CSR in encouraging competition and forming cooperative groups. In particular, it is shown that competition can be endogenously chosen but the multiproduct corporation will utilize CSR for inducing aggressive productions in both markets. This

[3]For studies on strategic CSR, see Goering (2007), Goering (2012), Kopel and Brand (2012), Brand and Grothe (2013), Lambertini and Tampieri (2015), Fanti and Buccella (2017) and Wang et al. (2018) among others. For studies on environmental responsibility, see Liu et al. (2015), Lee and Park (2019a,b), Chen et al. (2019) and Nie and Wang (2019).

[4]Kumar (1992) and Eckel and Neary (2010) point out that one characteristic of current economies is the presence of multiproduct firms.

result is consistently confirmed in a single-product homogeneous product competition in the literature of managerial delegation with CSR activities.[5] But, we consider a multiproduct market and show that CSR is monotonically increasing in product differentiation. Also, we show that a multiproduct CSR-corporation might have an incentive to form cooperative groups with lower CSR than that under competition. It is also shown that the relationship between CSR and product differentiation has an inverted U-shape. This suggests that detailed information about a firm's CSR should be taken into account if a government intends to encourage firms to be more competitive and more consumer-friendly.

The remainder of this paper is organized as follows: Section 2 presents the basic model. Section 3 analyzes a fixed cooperation game and then Section 4 analyzes an endogenous cooperation game. Finally, the conclusion is provided in Section 5.

2. The Model

We consider a market with a CSR-corp. and two uniplant for-profit firms, denoted by C, and F, respectively. They produce differentiated goods, denoted by 1 and 2. The CSR-corp. C has two plants. One plant produces good 1 and the other good 2, denoted by $1C$ and $2C$, respectively. Regarding the for-profit firms, one plant/firm produces good 1 and the other produces good 2, denoted by $1F$ and $2F$, respectively.

On the demand side, there is a continuum of consumers of the same type. The representative consumer has a utility function $U(q_1, q_2)$, which is quadratic, strictly concave and symmetric in q_1 and q_2: $U(q_1, q_2) = (q_1 + q_2) - ((q_1^2 + 2\delta q_1 q_2 + q_2^2))/2$, where $\delta \in [0, 1)$ and q_{ik} is the output produced by firm or plant ik, $i = 1, 2$; $k = C, F$. Then, the consumer maximizes $U(q_1, q_2) - p_1 q_1 - p_2 q_2$, where p_i is the price of good i, $q_1 = q_{1C} + q_{1F}$ and $q_2 = q_{2C} + q_{2F}$ are the quantity of good 1 and 2 respectively. The inverse demand functions are linear and given by:

$$p_i = 1 - (q_{iC} + q_{iF}) - \delta(q_{jC} + q_{jF}), \;\; i \neq j, \;\; i, j = 1, 2; \;\; 0 \leq \delta < 1 \tag{1}$$

where parameter δ measures the degree of product differentiation. The products are regarded as substitutes if $\delta > 0$ and independent if $\delta = 0$.

On the supply side, we assume that firms have identical technologies represented by the following quadratic cost function: $C(q_{ik}) = \frac{q_{ik}^2}{2}$, $i = 1, 2$; $k = C, F$. Thus, the profit function of a plant or firm ik is:

$$\pi_{ik} = p_i q_{ik} - \frac{q_{ik}^2}{2}, \;\; i = 1, 2; \;\; k = C, F \tag{2}$$

and the profit of the multiplant CSR-corp. is:

$$\pi_C = \pi_{1C} + \pi_{2C} \tag{3}$$

[5] See, for example, Goering (2007), Goering (2012), Lambertini and Tampieri (2015), Leal et al. (2018) and Garcia et al. (2019).

We consider a managerial delegation model of the CSR-corp., in which the owner and the manager are separated. To maximize the joint profits, the owner of CSR-corp. specifies an incentive contract with the manager. In this paper the manager is assumed to maximize the joint profits of its two plants plus a fraction (θ) of consumer surplus (CS) in production. Thus, the objective function of the manager of CSR-corp. is given by:

$$V = \pi_C + \theta CS \tag{4}$$

where $CS = ((q_{1C} + q_{1F})^2 + 2\delta(q_{1C} + q_{1F})(q_{2C} + q_{2F}) + (q_{2C} + q_{2F})^2)/2$. Note that parameter $\theta \in [0, 1]$ measures the degree of concern on consumer surplus when the corporation adopts CSR activities..

Our goal is to study how the different types of coordination affect the strategic choice of CSR effort and which kind of coordination emerges endogenously. In the below, we characterize the subgame perfect equilibrium under four alternative market structures: (i) competition, (ii) full cooperation among all firms, (iii) partial cooperation between CSR-corporation and one FP firm and (iv) only FP cooperation.

The game runs as follows: In the first stage, each firm's owner decides competition mode in choosing outputs whether coordinate or not, respectively. Then, we have the above four different scenarios in the following stages. In the second stage of the game, CSR-corp. sets up the managerial incentive scheme, θ to maximize the joint profits of its two plants. In the final stage, firms decide outputs in each case.

3. Fixed cooperation game

3.1. Competition

In stage 3, the manager of the CSR-corporation C chooses the outputs q_{1C} and q_{2C} that maximise eqn. (4). FP firm iF chooses the output q_{iF} that maximises its profit given by eqn.(2). Solving these problems, we obtain the following:

$$q_{iC} = \frac{2 + \theta(1 + \delta)}{8 + 7\delta + \delta^2 - 2\theta(1 + \delta)}, \qquad q_{iF} = \frac{2 - \theta + \delta(1 - \theta)}{8 + 7\delta + \delta^2 - 2\theta(1 + \delta)} \quad i = 1, 2 \tag{5}$$

From eqn. (5) we have that $\frac{\partial q_{iC}}{\partial \theta} > 0$, $\frac{\partial q_{iF}}{\partial \theta} < 0$ and $\frac{\partial q_i}{\partial \theta} > 0$. From, last inequality, we have that the market output always increases with CSR effort.

In stage 2, the owner of CSR-corp. chooses parameter θ to maximize (3). Solving it, we obtain the following result:

Lemma 1. *Under competition, in equilibrium:*

$$\theta^* = \frac{2(1 + \delta)}{11 + 5\delta}; \qquad q^*_{iC} = \frac{2}{7 + 5\delta}; \qquad q^*_{iF} = \frac{5 + 3\delta}{21 + 22\delta + 5\delta^2}$$
$$\pi^*_{iC} = \frac{2}{21 + 22\delta + 5\delta^2}; \qquad \pi^*_{iF} = \frac{3(5 + 3\delta)^2}{2\left(21 + 22\delta + 5\delta^2\right)^2}; \tag{6}$$

Note from Lemma 1 that:

a) $\frac{d\theta^*}{d\delta} > 0$, this means that the CSR monotonically increases with the degree of substitution, and this effect is weakened as the degree of substitution increases.

b) $\frac{dq_{iC}^*}{d\delta} < 0$ and $\frac{dq_{iF}^*}{d\delta} < 0$. Furthermore, $q_{iC}^* > q_{iF}^*$ for any $\delta \in [0,1)$.

c) $\frac{d\pi_{iC}^*}{d\delta} < 0$ and $\frac{d\pi_{iF}^*}{d\delta} < 0$. Furthermore, $\pi_{iC}^* > \pi_{iF}^*$ for any $\delta \in [0,1)$.

3.2. Full cooperation

Under this scenario, in the last stage, the objective function becomes $V + \pi_{1F} + \pi_{2F}$, and firms select outputs cooperatively. Solving this problem, we obtain the following:

$$q_{ik} = \frac{1}{5 + 4\delta - 2(1+\delta)\theta}, \;\; i = 1,2; \;\; k = C, F \tag{7}$$

From eqn. (7) we have that $\frac{\partial q_{ik}}{\partial \theta} > 0$, that is, the market output always increases with CSR effort.

In stage 2, the owner of CSR-corp. chooses parameter θ to maximize (3). Solving it, we obtain the following result:

Lemma 2. *Under full cooperation, in equilibrium:*

$$\begin{aligned} &\theta^{ful} = 0; && q_{iC}^{ful} = \frac{1}{5+4\delta}; && q_{iF}^{ful} = \frac{1}{5+4\delta} \\ &\pi_C^{ful} = \frac{1}{5+4\delta}; && \pi_{iF}^{ful} = \frac{1}{10+8\delta} \end{aligned} \tag{8}$$

where superecript *ful* stands for 'full cooperation'. Note from Lemma 2 that:

a) The CSR becomes null when the three firms coordinate in production.

b) $\frac{dq_{iC}^{ful}}{d\delta} < 0$ and $\frac{dq_{iF}^{ful}}{d\delta} < 0$. Furthermore, $q_{iC}^{ful} = q_{iF}^{ful}$ for any $\delta \in [0,1)$.

c) $\frac{d\pi_{iC}^{ful}}{d\delta} < 0$ and $\frac{d\pi_{iF}^{ful}}{d\delta} < 0$. Furthermore, $\pi_{iC}^{ful} = \pi_{iF}^{ful}$ for any $\delta \in [0,1)$.

3.3. Partial cooperation between CSR-corp. and FP firm i

Under this scenario, in the last stage, the CSR-corp. C and one FP firm coordinate their production to maximize their joint payoffs: $V + \pi_{iF}$, $i = 1,2$; while FP firm $-iF$ chooses the output q_{-iF} that maximizes its profits. Solving these problems, we obtain the following:

$$\begin{aligned} q_{-iC} &= \frac{10 + \theta - 2\theta^2 - \delta(10 - 4\theta) + 2\delta^2(1-\theta)^2}{40 - 26\theta + 4\theta^2 - \delta^2(22 - 20\theta + 4\theta^2)}, \quad q_{-iF} = \frac{10 - 9\theta + 2\theta^2 - 2\delta - 2\delta^2\left(2 - 3\theta + \theta^2\right)}{40 - 26\theta + 4\theta^2 - \delta^2(22 - 20\theta + 4\theta^2)}, \\ q_{ik} &= \frac{8 - 2\theta - 3\delta(2-\theta)}{40 - 26\theta + 4\theta^2 - \delta^2(22 - 20\theta + 4\theta^2)}, \qquad \pi_C = \frac{\Omega}{8\left(20 - 13\theta + 2\theta^2 - \delta^2(11 - 10\theta + 2\theta^2)\right)^2}, \;\; k = C, F \end{aligned} \tag{9}$$

where $\Omega = 4\left(155 - 150\delta - 60\delta^2 + 84\delta^3 - 15\delta^4\right) - 4\left(189 - 213\delta - 94\delta^2 + 165\delta^3 - 41\delta^4\right)\theta + \left(151 - 432\delta + 51\delta^2 + 384\delta^3 - 180\delta^4\right)$ $\left(68 + 72\delta - 164\delta^2 - 72\delta^3 + 96\delta^4\right)\theta^3 - 20\left(1 - \delta^2\right)^2\theta^4 > 0$.

Now, from eqn. (9) we have that $\frac{\partial q_{-iC}}{\partial \theta} > 0$, $\frac{\partial q_{-iF}}{\partial \theta} < 0$ and $\frac{\partial q_{-i}}{\partial \theta} > 0$. Furthermore, $\frac{\partial q_{ik}}{\partial \theta} > 0$. That is, market i's output always increases with CSR effort.

In stage 2, the owner of CSR-corp. chooses parameter θ to maximize (3). Solving it, we obtain the following result:[6]

Lemma 3. *Let $\bar{\theta}^{pc}$ satisfies $\frac{\partial \pi_C}{\partial \theta} = 0$. Then, under cooperation between CSR-corp. and one FP firm, in equilibrium:*

$$\begin{aligned} &\theta^{pc} = \bar{\theta}^{pc}; && q_{ik}^{pc} = q_{ik}(\theta^{pc}); && q_{-iC}^{pc} = q_{-iC}(\theta^{pc}); && q_{-iF}^{pc} = q_{-iF}(\theta^{pc}) \\ &\pi_{ik}^{pc} = \pi_{ik}(\theta^{pc}); && \pi_{-iC}^{pc} = \pi_{-iC}(\theta^{pc}); && \pi_{-iF}^{pc} = \pi_{-iF}(\theta^{pc}) \end{aligned} \tag{10}$$

where superscript *pc* stands for 'partial cooperation'. From Lemma 3 we have that:

a) $\frac{d\theta^{pc}}{d\delta}\big|_{\delta \to 0} > 0$ and $\frac{d\theta^{pc}}{d\delta}\big|_{\delta \to 1} < 0$, these results show that the optimal CSR is characterized by an inverse U curve in relationship to the degree of substitution. In other words, the relationship between the optimal CSR and the degree of substitution is non-monotonic.

b) $\frac{dq_{ik}^{pc}}{d\delta} < 0$ and $\frac{dq_{-ik}^{pc}}{d\delta} < 0$. Furthermore, $q_{-iC}^{pc} \lessgtr q_{-iF}^{pc}$ if $\delta \gtrless 0.2595$.

c) $\frac{d\pi_{ik}^{pc}}{d\delta} < 0$ and $\frac{d\pi_{-ik}^{pc}}{d\delta} < 0$. Furthermore, $\pi_{-iC}^{pc} \lessgtr \pi_{-iF}^{pc}$ if $\delta \gtrless 0.2595$.

3.4. Cooperation between FP firms only

Under this scenario, in the last stage, CSR-corp. C chooses the outputs q_{1C} and q_{2C} that maximise eqn. (4); while FP firms coordinate their production to maximize the joint profits: $\pi_{1F} + \pi_{2F}$. Solving these problems, we obtain the following:

$$q_{iC} = \frac{2 + \delta + (1+\delta)\theta}{(2+\delta)(4 + 3\delta - \theta(1+\delta))}, \qquad q_{iF} = \frac{2 + \delta - (1+\delta)\theta}{(2+\delta)(4 + 3\delta - \theta(1+\delta))}, \ \ i = 1, 2 \tag{11}$$

From eqn. (11) we have that $\frac{\partial q_{iC}}{\partial \theta} > 0$, $\frac{\partial q_{iF}}{\partial \theta} < 0$ and $\frac{\partial (q_{iC} + q_{iF})}{\partial \theta} > 0$.

In stage 2, the owner of CSR-corp. chooses parameter θ to maximize (3). Solving it, we obtain the following result:

Lemma 4. *Under cooperation between FP firms only, in equilibrium:*

$$\begin{aligned} &\theta^{ofc} = \frac{2 + 3\delta + \delta^2}{11 + 12\delta + 3\delta^2}; && q_{iC}^{ofc} = \frac{2+\delta}{7 + 8\delta + 2\delta^2}; && q_{iF}^{ofc} = \frac{5 + 5\delta + \delta^2}{(3+2\delta)(7 + 8\delta + 2\delta^2)} \\ &\pi_{C}^{ofc} = \frac{(2+\delta)^2}{(3+2\delta)(7 + 8\delta + 2\delta^2)}; && \pi_{iF}^{ofc} = \frac{\left(5 + 5\delta + \delta^2\right)^2}{2(3+2\delta)(7 + 8\delta + 2\delta^2)^2} \end{aligned} \tag{12}$$

where superscript *ofc* stands for "only FP cooperation". Note from Lemma 4 that:

a) $\frac{d\theta^{ofc}}{d\delta} > 0$, CSR monotonically increases with the degree of substitution, and this effect is weakened as the degree of substitution increases. As in the benchmark case where is no coordination.

b) $\frac{dq_{iC}^{ofc}}{d\delta} < 0$ and $\frac{dq_{iF}^{ofc}}{d\delta} < 0$. Furthermore, $q_{iC}^{ofc} > q_{iF}^{ofc}$ for any $\delta \in [0, 1)$.

c) $\frac{d\pi_{iC}^{ofc}}{d\delta} < 0$ and $\frac{d\pi_{iF}^{ofc}}{d\delta} < 0$. Furthermore, $\pi_{iC}^{ofc} > \pi_{iF}^{ofc}$ for any $\delta \in [0, 1)$.

[6] Proof is provided in Appendix A.

3.5. Comparing CSR levels

Having solved for the equilibrium levels of CSR under the four scenarios, we now compare them and report the following result.[7]

Proposition 1. *When the products are substitutes, CSR effort is the highest under competition regime while CSR effort is the lowest when all firms cooperate in productions.*

Proposition 1 shows that the strategic level of CSR depends on the market structures whether cooperation or competition. That is, cooperation might reduce strategic CSR activities while competition will encourage higher CSR. The economic explanation is as follows: In the managerial delegation of CSR where the managers take care of consumer surplus, it will encourage the firm to produce more aggressive output production. Thus, it will yield the first-mover advantage in the output competition game. This fact is already well-known in the literature of managerial delegation game.[8] However, under full cooperation, this incentive will disappear. Therefore, CSR under competition is the highest while CSR under cooperation is the lowest. This finding contributes to the understanding of the role of strategic CSR as a profit-increasing device.

4. Endogenous cooperation game

In the below, we analyzes an endogenous cooperation game where each firm's owners decides competition mode in choosing outputs whether coordinate or not, respectively, in the first stage. Then, we have the following table:

		FP 2			
		Coordinate "C"		Not Coordinate "NC"	
		FP 1		FP 1	
		C	NC	C	NC
CSR-corp.	C	$\pi_C^{ful}, \pi_{1F}^{ful}, \pi_{2F}^{ful}$	$\pi_C^{pc}, \pi_{-iF}^{pc}, \pi_{iF}^{pc}$	$\pi_C^{pc}, \pi_{iF}^{pc}, \pi_{-iF}^{pc}$	$\pi_C^*, \pi_{1F}^*, \pi_{2F}^*$
	NC	$\pi_C^{ofc}, \pi_{1F}^{ofc}, \pi_{2F}^{ofc}$	$\pi_C^*, \pi_{1F}^*, \pi_{2F}^*$	$\pi_C^*, \pi_{1F}^*, \pi_{2F}^*$	$\pi_C^*, \pi_{1F}^*, \pi_{2F}^*$

The equilibrium outcomes are as follows:[9]

i) 'Full cooperation', that is, (C, C, C) emerges as an equilibrium if $\pi_C^{ful} \geq \pi_C^{ofc}$, $\pi_{1F}^{ful} \geq \pi_{-iF}^{pc}$ and $\pi_{2F}^{ful} \geq \pi_{-iF}^{pc}$, hold simultaneously.

ii) 'CSR-corp. and FP firm 2 cooperation', that is, (C, NC, C) emerges as an equilibrium if $\pi_C^{pc} \geq \pi_C^*$, $\pi_{-iF}^{pc} \geq \pi_{1F}^{ful}$ and $\pi_{iF}^{pc} \geq \pi_{2F}^*$, hold simultaneously.

[7] Appendix B provides the CSR ranking under different regimes.

[8] For more discussion on this fact, see Lambertini and Tampieri (2015), Leal et al. (2018) and Garcia et al. (2019).

[9] Appendix C provides the profits ranking under different regimes.

iii) 'CSR-corp. and FP firm 1 cooperation', that is, (C, C, NC) emerges as an equilibrium if $\pi_C^{pc} \geq \pi_C^*$, $\pi_{iF}^{pc} \geq \pi_{1F}^*$ and $\pi_{-iF}^{pc} \geq \pi_{2F}^{ful}$, hold simultaneously.

iv) 'Only FP cooperation', that is, (NC, C, C) emerges as an equilibrium if $\pi_C^{ofc} \geq \pi_C^{ful}$, $\pi_{1F}^{ofc} \geq \pi_{1F}^*$ and $\pi_{2F}^{ofc} \geq \pi_{2F}^*$, hold simultaneously.

v) 'Competition', that is, (NC, NC, NC) emerges as an equilibrium if $\pi_C^* \geq \pi_C^*$, $\pi_{1F}^* \geq \pi_{1F}^*$ and $\pi_{2F}^* \geq \pi_{2F}^*$, hold simultaneously.

Proposition 2. *From the comparisons, we obtain the following results:*
(i) Full cooperation is an equilibrium for lower degree of substitutability but yields no CSR
(ii) Partial cooperation is an equilibrium for higher degree of substitutability but yields lower CSR than competition
(iii) Competition is an equilibrium for any degree of substitutability and yields the highest CSR
(iv) Cooperation between FP only is not an equilibrium

Proposition 2 shows that cooperation or competition can be chosen endogenously among the firms, but cooperation might reduce strategic CSR activities while competition will encourage higher CSR. This finding contributes to the understanding of the role of profit-oriented CSR in encouraging competition and forming cooperative groups. In particular, it reports that a multiproduct CSR-corp. might have an incentive to form partial cooperative groups with lower CSR than that under competition, in which the relationship between CSR and substitutability has an inverted U-shape. This suggests that detailed information about a firm's CSR should be taken into account if a government intends to encourage firms to be more competitive and more consumer-friendly.

5. Concluding Remarks

This paper considered an industry comprised of a multiproduct corporation that adopts CSR as a strategic managerial delegation, and examined the profit-incentive of a CSR-corp. to form a cooperative group with other firms in each market. We introduced exogenously specified groups in which the groups pursue their own interests subject to incentive compatibility constraints and then identified the necessary conditions of product substitutability that the multiproduct CSR-corp. chooses endogenous cooperative group formation.

Our findings showed that cooperation might reduce strategic CSR activities while competition will encourage higher CSR but lower industry profits. Therefore, competition will encourage the profit-oriented CSR while firms have an incentive to form cooperative groups with lower CSR activities. This suggests that detailed information about CSR firms should be taken into account if a government intends to encourage firms be more competitive and more consumer-friendly.

There remain some limitations of our analysis. We adopt a simple Cournot model of managerial delegation game when we endogenize the strategic CSR-initiatives. We need to examine the analysis with an oligopolistic market with price competition and compare the welfare effects of cooperation. Finally, recent analysis of CSR has been extended

to incorporate environmental concerns and investigated the conflict of incentives in CSR. [10] These are future research directions for real practice in CSR activities.

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[10] See, for example, Lambertini and Tampieri (2015), Leal et al. (2018), Lee and Park (2019a,b), Garcia et al. (2019), Nie et al. (2019) and Chen et al. (2019).

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Appendix A. Proof of Lemma 3

$\frac{\partial^2 \pi_C}{\partial \theta^2} < 0$ for any $\theta \in [0,1]$ and $\delta \in [0,1)$. Now $\frac{\partial \pi_c}{\partial \theta}\big|_{\theta \to 0} = \frac{250+360\delta-701\delta^2-459\delta^3+596\delta^4+135\delta^5-151\delta^6}{2(20-11\delta^2)^3} > 0$ for any $\delta \in [0,1)$ and $\frac{\partial \pi_c}{\partial \theta}\big|_{\theta \to 1} = \frac{-306-18\delta+447\delta^2-84\delta^3-181\delta^4+78\delta^5-6\delta^6}{36(3-\delta^2)^3} < 0$ for any $\delta \in [0,1)$. The fact that $\frac{\partial \pi_c}{\partial \theta}\big|_{\theta \to 0} > 0$ and $\frac{\partial \pi_c}{\partial \theta}\big|_{\theta \to 1} < 0$ implies the existence of $\bar{\theta} \in (0,1)$ such that $\frac{\partial \pi_C}{\partial \theta} = 0$.

Appendix B. CSR ranking

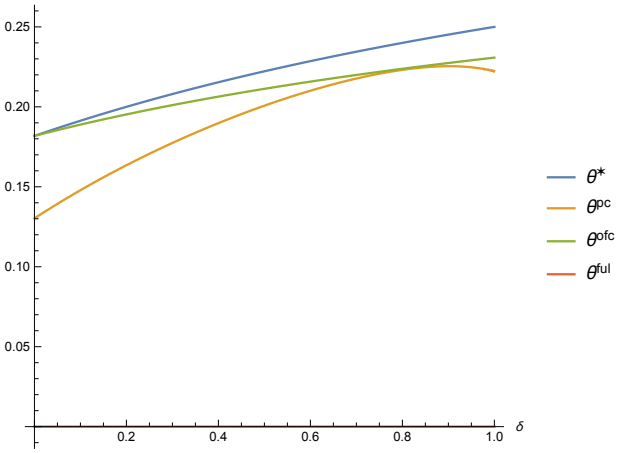
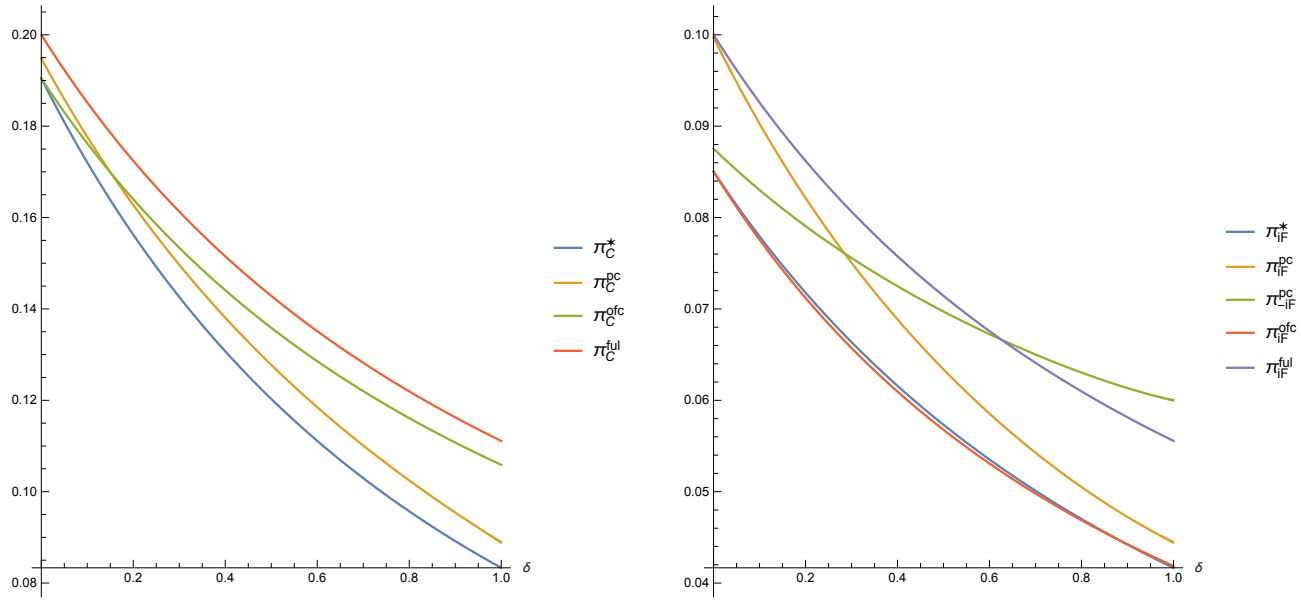


Figure B.1

Based on Fig. B.1, the CSR efforts (equilibrium) in the different regimes are arranged in the following form

- $\theta^* > \theta^{ofc} > \theta^{pc} > \theta^{ful} = 0$ when products are substitutes.

Appendix C. Profits ranking



(a) CSR-corp.'s profits

(b) FP firm i's profits

Figure C.2

Based on Fig. C.2a, the CSR-corporation's profits (equilibrium) in the different regimes are arranged in the following form

- $\pi_C^{ful} > \pi_C^{pc} > \pi_C^{ofc} \geq \pi_C^*$ when $0 \leq \delta < 0.152094$; and
- $\pi_C^{ful} > \pi_C^{ofc} \geq \pi_C^{pc} > \pi_C^*$ when $0.152094 \leq \delta < 1$.

Based on Fig. C.2b, the FP firm i's profits (equilibrium) in the different regimes are arranged in the following form

- $\pi_{iF}^{ful} > \pi_{iF}^{pc} > \pi_{-iF}^{pc} > \pi_{iF}^* \geq \pi_{iF}^{ofc}$ when $0 \leq \delta < 0.28462$;
- $\pi_{iF}^{ful} > \pi_{-iF}^{pc} \geq \pi_{iF}^{pc} > \pi_{iF}^* > \pi_{iF}^{ofc}$ when $0.28462 \leq \delta < 0.62591$;
- $\pi_{-iF}^{pc} \geq \pi_{iF}^{ful} > \pi_{iF}^{pc} > \pi_{iF}^* > \pi_{iF}^{ofc}$ when $0.62591 \leq \delta < 0.882995$;
- $\pi_{-iF}^{pc} > \pi_{iF}^{ful} > \pi_{iF}^{pc} > \pi_{iF}^{ofc} \geq \pi_{iF}^*$ when $0.882995 \leq \delta < 1$