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Abstract

We analyze a delegation game relevant to the conduct of corporate social responsibility (CSR) in which the firm's owner offers the manager a contract consisting of firm profit and social welfare. We derive three results that distinctly differ from existing findings. First, CSR decisions are strategic complements for firms. Second, with simultaneous CSR decisions, the equilibrium price is equal to marginal cost, despite the fact that firms compete in a Cournot duopoly. Finally, with sequential CSR decisions, unlike the follower firm, the leader firm never exhibits CSR. However, the follower firm can enjoy a profit equal to that derived by the leader in a Cournot–Stackelberg game.

Keywords *Corporate social responsibility, Cournot, Strategic substitute, Strategic complement*
JEL Classification L13 · L21 · M14

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1 Introduction

Many firms pursue not only their own profits but also corporate social responsibility (CSR). Then again, some firms do not exhibit CSR. A large number of empirical studies have shown how introducing CSR affects firm performance. However, the results are mixed. In evidence, Margolis and Walsh (2003) survey 109 analyses of the relationship between CSR and firm financial performance and find a positive relationship in 54 studies, a negative relationship in 7 studies, and insignificant relationships in 28 studies. The remaining 20 studies report mixed findings. Consequently, the potential for firm profitability to improve following the introduction of CSR remains controversial. The purpose of this paper is to develop a theoretical framework to enable us to understand which firms have an incentive to exhibit CSR as a means of maximizing their profits.

Recently, some studies have examined the components of firm objective functions outside their own profits, including that relating to CSR, comprising social welfare and consumer surplus. For example, Matsumura and Ogawa (2014) examine the former and thus assume that firms care about both their own profits and social welfare.[1] They then investigate an endogenous timing game in which firms choose their actions and the timing of these actions. Alternatively, Kopel and Brand (2012) and Goering (2012) focus on the latter and thus regard firm objectives as comprising both profits and consumer surplus. Kopel and Brand (2012) consider that the social responsible owner offers the manager a contract including the firm's profit and sales revenue to maximize the weighted sum of profit and consumer surplus. They then consider competition between a socially responsible firm and a profit-maximizing firm in which both firms decide if they wish to hire a manager for their firm. In this paper, we consider that the profit-maximizing owner offers the manager a compensation contract concerning CSR. In this, it is the very nature of firms to maximize their own profits, and it is to this end that firms execute their many strategies. Elsewhere, Goering (2012) considers a bilateral monopoly model with an upstream manufacturer and a downstream retailer whose payoff consists of both profit and consumer surplus. Overall, these studies focus on the effects of firm CSR on competition given the assumption that the levels of firm CSR are exogenously given. To the best of

[1]Some argue we can view an objective function consisting of both firm profit and social welfare as partial privatization. See Matsumura (1998) for details.

our knowledge, Goering (2014) is the first study that explores endogenous decisions concerning the level of firm CSR. Goering (2014) assumes that in a bilateral monopoly model, the retailer must maximize its weighted payoff, including both its own profit and consumer surplus, as offered by the manufacturer. Because the manufacturer can control the payoff of the retailer, the manufacturer can derive its maximal profit, as derived in a two-part tariff scheme.

This paper analyzes endogenous decision making concerning the level of CSR in a delegation game as distinct from the vertical distribution channel model considered in Goering (2012, 2014). The literature on delegation studies has established that the owner offers an incentive contract including sales revenue (Vickers, 1985; Fershtman and Judd, 1987; Sklivas, 1987), market share (Jansen et al., 2007), and a rival firm's profit (Aggarwal and Samwick, 1999). This paper studies the delegation game in which the firm's owner offers the manager a contract taking considering the weighted average of profit and either consumer surplus or social welfare. We then interpret CSR as an incentive contract regarding either consumer surplus or social welfare.

We initially consider a benchmark case in which each owner offers managers an incentive contract consisting of a firm's profit and consumer surplus before competing in a Cournot fashion. A number of studies have investigated incentive contracts concerning sales, market share, and rival firm profits, which to a greater or lesser extent affect its manager's decision to produce aggressively. Using an incentive contract including consumer surplus, we derive similar results to those reported in several prior delegation studies. In brief, increasing the level of CSR can serve as a commitment device and thus make firms produce aggressively in the market. Decisions about the CSR level are then strategic substitutes. Thus, we show that the leader (follower) exhibits a higher (lower) level of CSR in a sequential-choice game than in a simultaneous-choice game.[2]

However, when each owner offers managers a contract consisting of a firm's profit and social welfare, we derive the following results. When firms simultaneously choose their CSR levels, both firms maximize only social welfare and set their price at the marginal cost, despite competing in a Cournot fashion. As is the case of an incentive contract regarding consumer sur-

[2]We assume that consumers benefit only from their own consumption. A number of other studies also assume that consumers are concerned with the social activities of firms and show that firms exhibit CSR in order to meet the corresponding preferences of socially-conscious consumers (Baron, 2001; Kopel, 2009; Manasakis et al., 2014).

plus (as in several existing delegation studies), increasing the share of social welfare in the firm's objective can serve as a commitment device to produce aggressively in the product market. Therefore, each firm exhibits CSR. However, when compared with consumer surplus, the case of social welfare leads to a more competitive equilibrium outcome, which is equivalent to perfect competition. The decision concerning CSR is then a strategic complement.[3] It is well known that there is a second-mover advantage for strategic complements (Gal-Or, 1985). Consistent with this, we show that the follower can derive a greater profit than the leader and achieve maximum profit when firms sequentially choose their CSR level, which is as derived by the leader in Cournot–Stackelberg competition where the leader chooses its output before the follower. In addition, the leader does not exhibit the CSR whereas the follower does. To the best of our knowledge, this study is then the first to suggest that all firms do not necessarily exhibit CSR.

The remainder of the paper is organized as follows. In Section 2, we develop the basic model for the delegation game relevant to firm CSR. In Sections 3 and 4, we derive the equilibrium outcomes when the owner offers the manager an incentive contract respectively including consumer surplus and social welfare in addition to the firm's profit. Section 5 concludes.

2 Model

We consider a delegation game in which the owner of each firm offers its manager an incentive contract. This paper adapts an incentive contract that considers the weighted average of profit and corporate social responsibility (CSR), where we interpret CSR as either consumer surplus, CS, or social welfare, SW. The objective function of manager i is given by

$$O_i = (1 - \alpha_i)\pi_i + \alpha_i y_i,$$

where y_i takes on consumer surplus or social welfare ($y_i \in \{CS, SW\}$). In this analysis, CS is given by $bQ^2/2$ and SW is given by $\{2(a-c) - bQ\}Q/2$. Managers compete in a market in order to maximize their objective functions. Owner i then chooses α_i to maximize profit, π.

[3]In this analysis, we define strategic complements by whether the signs of the slopes of the firms' reaction functions are positive.

We consider Cournot competition in which two managers compete in quantities q_i $(i = 1, 2)$ in a homogeneous product market.[4] The inverse demand function is given by $p = a - bQ$, where p is the price and $Q = \sum q_i$ is the total output. We assume a constant marginal cost of supplying products, $c \in (0, a)$.

We investigate the following two types of timing in both objective functions. The first is a simultaneous-choice game. In stage 1, the owner of firm i decides an incentive contract for its manager regarding that level of CSR α_i to maximize its profit π_i. In stage 2, the manager of firm i chooses quantities q_i to maximize its objective function O_i that is written in an incentive contract decided at stage 1. The second type of timing is a sequential-choice game. In stage 1, the owner of firm 1 decides an incentive contract regarding the level of CSR α_1 to maximize its profit π_1. Similarly, in stage 2, the owner of firm 2 decides an incentive contract regarding the level of CSR α_2. In stage three, the manager of firm i chooses quantities q_i to maximize its objective function O_i that is decided at either stage 1 or 2.

3 Benchmark Case: Profit and Consumer Surplus

In this section, we consider the situation where each owner offers its manager an incentive contract consisting of profit and consumer surplus as the benchmark: $O_i = (1 - \alpha_i)(p - c)q_i + \alpha_i \cdot CS$.

3.1 Simultaneous choice

We investigate the simultaneous decisions about CSR. Suppose that $\alpha_i = 1$ holds for some i. Then, firm i maximizes consumer surplus and obtains negative profit because the market price goes to zero and the constant marginal cost of supplying products c is positive. Hence, we can focus only on the case where α_1 and α_2 are smaller than one.

In stage 2, we derive the following first-order conditions by differentiating O_i with respect to q_i.

[4]We also investigated the case of Bertrand competition. However, we confirm that no firm exhibits the CSR activity, that is, each firm chooses $\alpha_i = 0$ in the equilibrium.

$$\frac{\partial O_i}{\partial q_i} = 0 \Rightarrow q_i = \frac{a-c}{b} - Q + \frac{\alpha_i}{1-\alpha_i} Q$$

Using this, we have price, quantities, and profits as follows:

$$\begin{aligned}
p =& c + \frac{1 - 2\alpha_1 - 2\alpha_2 + 3\alpha_1\alpha_2}{3 - 4\alpha_1 - 4\alpha_2 + 5\alpha_1\alpha_2}(a-c) = c + \frac{1 - \frac{\alpha_1}{1-\alpha_1} - \frac{\alpha_2}{1-\alpha_2}}{3 - \frac{\alpha_1}{1-\alpha_1} - \frac{\alpha_2}{1-\alpha_2}}(a-c), \\
q_i =& \frac{1 - 2\alpha_j + \alpha_1\alpha_2}{3 - 4\alpha_1 - 4\alpha_2 + 5\alpha_1\alpha_2} \cdot \frac{a-c}{b}, \\
\pi_i =& \left(\frac{1 - 2\alpha_1 - 2\alpha_2 + 3\alpha_1\alpha_2}{3 - 4\alpha_1 - 4\alpha_2 + 5\alpha_1\alpha_2}\right)\left(\frac{1 - 2\alpha_2 + \alpha_1\alpha_2}{3 - 4\alpha_1 - 4\alpha_2 + 5\alpha_1\alpha_2}\right) \cdot \frac{(a-c)^2}{b}.
\end{aligned}$$

Hence, $p > c$ implies that α_1 and α_2 are smaller than a half. Next, we consider the decisions in stage 1. Taking the first-order conditions determining the optimal α_i, we obtain the best-response functions of firm i:

$$\frac{\partial \pi_i}{\partial \alpha_i} = 0 \iff \alpha_i(\alpha_j) = \frac{(1-2\alpha_j)^2}{4 - 11\alpha_j + 8\alpha_j^2}. \tag{1}$$

In this paper, we define strategic substitutes and complements as follows.

Definition 1. *Strategic variables are substitutes (complements) if the owners' reaction functions have a negative (positive) slope.*

Following this definition, we derive Proposition 1.

Proposition 1. *When each owner can offer a manager an incentive contract consisting of the firm's profit and consumer surplus, decisions about the CSR level (α_i) in stage 1 are strategic substitutes.*

Proof. If price p is greater than marginal cost c, then α_1 and α_2 are smaller than a half. Thus, differentiating (1) with respect to α_j yields

$$\frac{\partial \alpha_i}{\partial \alpha_j} = -\frac{1}{12}\frac{(\frac{1}{2} - \alpha_j)(\frac{5}{6} - \alpha_j)}{(4 - 11\alpha_j + 8\alpha_j^2)^2} < 0.$$

□ □

Proposition 1 shows that increasing the level of CSR can serve as a commitment device for firms to produce aggressively in the market. Solving simultaneous equations (1) yields two solutions, $\alpha_i = (7 \pm \sqrt{17})/16$. However, only the smaller, $\alpha_i = (7-\sqrt{17})/16$, satisfies the second-order condition for maximization. We can also derive the equilibrium price, quantities, and profits as summarized in the following Proposition 2.

Proposition 2. *When each owner can offer a manager an incentive contract consisting of the firm's profit and consumer surplus, we derive the equilibrium levels of CSR, price, quantities, and profits as follows:*

$$\alpha_i^{CS} = \frac{7-\sqrt{17}}{16}, \quad p^{CS} = a - \frac{\sqrt{17}-1}{4}(a-c),$$
$$q_i^{CS} = \frac{\sqrt{17}-1}{8} \cdot \frac{a-c}{b} > \frac{a-c}{3b}, \quad \pi_i^{CS} = \frac{3\sqrt{17}-11}{16} \cdot \frac{(a-c)^2}{b} < \frac{(a-c)^2}{9b}.$$

Each firm exhibits CSR as an equilibrium outcome. This leads to lower prices, greater quantities, and lower profits than in the absence of CSR.

3.2 Sequential choice

Here, we consider the sequential-choice game in which firm 1 chooses the extent of its CSR before firm 2. Therefore, we use the suffix L to denote the leader (firm 1) and the suffix F to denote the follower (firm 2). We can use the result derived above for the analysis in stage 2. The follower's CSR level is given by

$$\alpha_F(\alpha_L) = \frac{(1-2\alpha_1)^2}{4-11\alpha_L+8\alpha_L^2}. \tag{2}$$

Substituting (2) into the profit function of the owner of the leader firm, we obtain the objective function in stage 1. We can derive the leader's equilibrium CSR level from the first-order condition determining the optimal α_L.[5]

$$\pi_L = \left(\frac{1-2\alpha_L-2\alpha_F(\alpha_L)+3\alpha_L\alpha_F(\alpha_L)}{3-4\alpha_L-4\alpha_F(\alpha_L)+5\alpha_L\alpha_F(\alpha_L)}\right)\left(\frac{1-2\alpha_F(\alpha_L)+\alpha_L\alpha_F(\alpha_L)}{3-4\alpha_L-4\alpha_F(\alpha_L)+5\alpha_L\alpha_F(\alpha_L)}\right) \cdot \frac{(a-c)^2}{b}$$

[5]We can confirm that the second-order necessary condition for local maxima is satisfied at $\alpha_L = \alpha_L^{CS}$.

$$
\begin{aligned}
&= \frac{(1-2\alpha_L)(1-2\alpha_L^2)}{4(1-\alpha_L)(2-3\alpha_L)^2} \cdot \frac{(a-c)^2}{b}, \\
\frac{\partial \pi_L}{\partial \alpha_L} &= \frac{4-23\alpha_L+40\alpha_L^2-22\alpha_L^3}{4(1-\alpha_L)^2(2-3\alpha_L)^3} \cdot \frac{(a-c)^2}{b} = 0 \quad \Rightarrow \quad \alpha_L^{CS} \approx 0.32,
\end{aligned}
$$

We can also derive the follower's equilibrium CSR level α_F^{CS} by substituting α_L^{CS} into (2):

$$
\alpha_F^{CS} \approx 0.10.
$$

From these results and Proposition 2, we derive the following proposition.

Proposition 3. *The equilibrium CSR levels in simultaneous- and sequential-choice models are ordered as follows:*

$$
\alpha_F^{CS} < \alpha_i^{CS} < \alpha_L^{CS}, \quad i = 1, 2.
$$

We can see that when compared with the simultaneous-choice game, the leader introduces a greater CSR level, whereas the follower does the opposite. This result crucially depends on the fact that:

$$
\frac{\partial q_j}{\partial \alpha_i} = -\frac{(1-\alpha_j)(1-2\alpha_j)}{(3-4\alpha_i-4\alpha_j+5\alpha_i\alpha_j)^2} \frac{2(a-c)}{b}
$$

is negative if and only if $\alpha_j < 1/2$. This implies that firm i is willing to adopt an aggressive behavior (i.e., choose a higher α_i) as long as the other firm is not very aggressive. The leader firm then has an incentive to exhibit CSR aggressively. The follower who observes the leader's aggressive choice introduces CSR passively, which is less than that derived under the simultaneous-decision game.

We derive the equilibrium price, quantities, and profits as shown in Table 1.

4 Profit and Social Welfare

Here, we consider the situation where owners offer their managers incentive contracts consisting of profit and social welfare: $O_i = (1-\alpha_i)(p-c)q_i + \alpha_i \cdot SW$. The timing of the game is identical to that considered in the previous section. We only modify the form of the incentive contracts offered by the owners.

4.1 Simultaneous choice

We initially investigate the simultaneous-decision game before extending our analysis to the sequential-decision game. The first-order conditions determining the optimal q_i are

$$\frac{\partial O_i}{\partial q_i} = 0 \Rightarrow q_i = \frac{a - c - bq_j}{b(2 - \alpha_i)}$$

Using these reaction functions, we derive the price, quantities, and profits.

$$\begin{aligned}
p &= \begin{cases} 0 & \text{if } \alpha_1 = \alpha_2 = 1, \\ c + \dfrac{(1-\alpha_1)(1-\alpha_2)(a-c)}{3 - 2\alpha_1 - 2\alpha_2 + \alpha_1\alpha_2} & \text{otherwise,} \end{cases} \\
q_i &= \begin{cases} \dfrac{a-c}{b} - q_j & \text{if } \alpha_1 = \alpha_2 = 1, \\ \dfrac{1-\alpha_j}{3 - 2\alpha_1 - 2\alpha_2 + \alpha_1\alpha_2} \cdot \dfrac{a-c}{b} & \text{otherwise,} \end{cases} \\
\pi_i &= \begin{cases} 0 & \text{if } \alpha_1 = \alpha_2 = 1, \\ \dfrac{(1-\alpha_i)(1-\alpha_j)^2}{3 - 2\alpha_1 - 2\alpha_2 + \alpha_1\alpha_2} \cdot \dfrac{(a-c)^2}{b} & \text{otherwise.} \end{cases}
\end{aligned}$$

Next, we consider the decisions in stage 1. When $\alpha_j = 1$, the owner of firm i is indifferent between all of the CSR levels, $\alpha_i \in [0, 1]$, because the price is zero whatever choice is made. When it holds that $\alpha_j < 1$, the first-order conditions determining the optimal α_i are

$$\frac{\partial \pi_i}{\partial \alpha_i} = 0 \Rightarrow \alpha_i(\alpha_j) = \frac{1}{2 - \alpha_j}.$$

From these reaction functions, we obtain the following proposition.

Proposition 4. *When each owner can offer a manager an incentive contract consisting of the firm's profit and social welfare, the decisions on the CSR level (α_i) in stage 1 are strategic complements.*

The decisions in stage 1 are strategic complements despite firms actually undertaking quantity competition in the market. The change of form of the incentive contracts from consumer surplus to social welfare leads to the change in competitive structure.

Given the reaction function, $\alpha_i(\alpha_j) > \alpha_j$ for any $\alpha_j \in (0,1)$. That is, each owner has an incentive to introduce CSR more aggressively than does its rival. Thus, we can derive the following proposition from the results noted above.

Proposition 5. *When each owner can offer a manager an incentive contract consisting of the firm's profit and social welfare, we derive the equilibrium levels of CSR, price, quantities, and profits as follows:*

$$\alpha_i^{SW} = 1, \quad p^{SW} = c, \quad q_1^{SW} + q_2^{SW} = \frac{a-c}{b}, \quad \pi_i^{SW} = 0.$$

Decisions about the CSR level (α_i) are strategic complements, as shown in Proposition 4. We observe that each owner has an incentive to introduce CSR more aggressively than does its rival. This leads the competitive structure to behave similarly to Bertrand competition. The equilibrium outcome then depends on the tie-breaking rule as in the case of Bertrand competition. If the tie-breaking rule is equal sharing, we can derive the symmetric equilibrium, $q_1^{SW} = q_2^{SW} = \frac{a-b}{2b}$.

As a result, if a competitive environment exists where firms pursue not only profit, but also social welfare, without government regulation, competition in a Cournot duopoly market can achieve welfare maximization.

4.2 Sequential choice

We now analyze the sequential-choice game, for which we use the results derived in the simultaneous-choice game. As in the case of consumer surplus, we use the suffix L to denote the leader (firm 1) and the suffix F to denote the follower (firm 2). Substituting the best-response of the owner of the follower firm into the leader firm's profit and taking the first-order conditions and solving for α_1, we obtain the equilibrium CSR level as follows:

$$\begin{aligned}
\pi_L =& \frac{(1-\alpha_L)(1-\alpha_F(\alpha_L))^2}{3-2\alpha_L-2\alpha_F(\alpha_L)+\alpha_L\alpha_F(\alpha_L)} \cdot \frac{(a-c)^2}{b} \\
=& \frac{(1-\alpha_L)^2}{2(2-\alpha_L)^2} \cdot \frac{(a-c)^2}{b} \\
\frac{\partial \pi_L}{\partial \alpha_L} =& -\frac{1-\alpha_L}{(2-\alpha_L)^3}\frac{(a-c)^2}{b} < 0 \quad \Rightarrow \quad \alpha_L^{SW} = 0.
\end{aligned}$$

Using this value, we derive the following proposition.

Proposition 6. *When each owner can sequentially offer a manager an incentive contract consisting of the firm's profit and social welfare, we obtain the equilibrium levels of CSR, price, quantities, and profits as follows:*

$$\alpha_L^{SW} = 0, \quad \alpha_F^{SW} = \frac{1}{2}, \quad p^{SW} = \frac{a+3c}{4}, \quad q_L^{SW} = \frac{a-c}{4b}, \quad q_F^{SW} = \frac{a-c}{2b},$$
$$\pi_L^{SW} = \frac{(a-c)^2}{16b}, \quad \pi_F^{SW} = \frac{(a-c)^2}{8b},$$

Proposition 6 shows that the leader maximizes only its profit, while the follower maximizes the standard average of profit and social welfare, that is, only the follower exhibits CSR. Interestingly, we also find that the follower can achieve its maximum profit in the quantity competition model, which is as derived by the leader in Cournot–Stackelberg competition. As in Proposition 4, decisions about the CSR level (α_i) are strategic complements and lead to a second-mover advantage despite the firms actually choosing quantities as strategic variables in the market.

5 Conclusion

The purpose of this paper is to provide a theoretical framework for understanding which firms have an incentive to exhibit CSR to maximize their profits. To this end, we proposed a delegation game relevant to CSR in which the firm owners offer the manager a contract consisting of firm profit and CSR. We consider two types of CSR: consumer surplus and social welfare. The owner determines the weight of CSR and then the manager decides the quantities to maximize the weighted payoff offered by the owner. We find that when the contract consists of profit and consumer surplus, the firm's CSR decisions are strategic substitutes. Therefore, increasing the CSR level can serve as a commitment device to produce aggressively in the market. This result is consistent with several existing delegation studies, in which the owner offers a contract including either sales or market share. Thus, if the levels of firm CSR are determined sequentially, the leader firm exhibits a higher CSR level than does the follower firm.

When firms maximize the payoff including their own profits and social welfare, we derive three results that are distinctly different from those in existing studies. First, firm CSR decisions are strategic complements, despite the fact that the firms compete in quantity. Second, with simultaneous CSR

decisions, both firms behave as social planners, that is, they only maximize social welfare. Further, the equilibrium price equals marginal cost, as in the case of Bertrand competition. Finally, with sequential CSR decisions, the leader pursues profit only while the follower maximizes the standard average of its profit and social welfare, that is, the leader has no incentive to exhibit CSR. Interestingly, the firm that does not only maximize its profit can enjoy a greater profit than the firm that only pursues profit. In addition, the profit that the follower enjoys is equal to that derived by the leader in a Cournot–Stackelberg game.

The unique theoretical contribution of our work lies in showing when and which firms exhibit CSR to maximize their own profits, including where some firms do not exhibit CSR at all. The extant literature focuses only on the effects of introducing CSR. Therefore, our findings can explain why some firms do not exhibit CSR at all. That said, in this analysis, the types of CSR are exogenously determined as either consumer surplus or social welfare. We defer the more general analysis of incentive contracts to future research.

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Appendix

Table 1 summarizes the equilibrium outcomes in two significant figures.

Table 1: Summary of Propositions

		α	p	q	π
CS (simultaneous choice)	Firm 1	0.18	0.22	0.39	0.086
	Firm 2	0.18	0.22	0.39	0.086
CS (sequential choice)	Firm 1	0.32	0.17	0.57	0.097
	Firm 2	0.10	0.17	0.26	0.042
SW (simultaneous choice)	Firm 1	1	0	$q_1^* (\in [0,1])$	0
	Firm 2	1	0	$1 - q_1^*$	0
SW (sequential choice)	Firm 1	0	0.25	0.25	0.063
	Firm 2	0.5	0.25	0.5	0.13

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