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Why Firms Should Care for Consumers: Complementary Goods

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Abstract: Corporate social responsibility (CSR) is a business approach that cares for social and environmental issues, and customer orientation (CO) is a business strategy that focuses on the needs and wishes of customers at the centre of all decision-making. This paper examines two games of Cournot duopoly in which two profit-maximising firms produce complementary goods. The first game is that the firms consider the surplus of all consumers (CSR) as corporate culture, and the second game is that the firms care only for their own customers (CO). This paper presents the respective optimal levels of CSR and CO. Furthermore, the paper shows that all the profits at these optimal levels are the same.

Keywords: Complementary goods; Consumer surplus; Cournot model; Customer surplus

JEL classification: C72; D21

1. Introduction

Corporate social responsibility (CSR) has been a growing trend in recent decades. Nearly 90% of the 250 largest global companies issued CSR reports in 2015, up from 35% in 1999 (KPMG, 2015). There are many theoretical research papers on CSR firms (for example, see Goering, 2007; Kopel & Brand, 2012; Lambertini & Tampieri, 2012; Kopel, Lamantia & Szidarovszky, 2014; Kopel, 2015; Fanti & Buccella, 2016, 2018; Flores & García, 2016; Ouattara, 2017; García, Leal & Lee, 2019; Han, 2019; Ohnishi, 2022). Lambertini and Tampieri (2012) considered a Cournot oligopoly model with pollution where a CSR firm competed with profit-maximising firms and demonstrated that the CSR firm could earn higher profits compared to profit-maximising firms. Ouattara (2017) considered two cases of a Cournot mixed duopoly consisting of one state-owned public firm and one CSR firm. The first case was that of a CSR firm owned by domestic private investors. The second case was that of a CSR firm owned by foreign private investors. He showed that the optimal degree of privatisation in a domestic mixed duopoly is not always higher than that obtained in an international mixed duopoly. Fanti and Buccella (2018) considered a two-stage game model in which two firms produced

homogeneous network goods. In the first stage, each firm chose its level of CSR, and in the second stage, a standard Cournot-Nash competition took place. It was shown that the equilibrium in which both firms had social concerns was more profitable than simple profit-seeking for sufficiently intense network externalities.

Furthermore, customer orientation (CO) is a business approach that focuses on the needs and wishes of customers at the center of all decision-making. For example, Königstein and Müller (2001) considered a Cournot duopoly model in which two firms could care for their respective customers' surplus in addition to their own profits and demonstrated that such customer orientation might be beneficial for the firms.

Planer-Friedrich and Sahm (2018) considered a three-stage Cournot duopoly model in which two profit-maximising firms produce homogeneous goods. In the first stage, each firm simultaneously and independently chose to care for the surplus of either all consumers (CSR) or their own customers only (CO). In the second stage, each firm simultaneously and independently chose its level of CSR or CO. In the third stage, each firm simultaneously and independently decided upon its output level. Planer-Friedrich and Sahm demonstrated that firms preferred to care for all consumers.

In the real world, we can find a large number of examples of complementary goods such as bread and jam, coffee and sugar, salad and salad dressing, and computer hardware and computer software. Therefore, we examined a Cournot duopoly model in which two profit-maximising firms produce complementary goods. We considered two one-shot Cournot-Nash games: (i) both firms cared for the surplus of all consumers (CSR), and (ii) both firms cared for their own customers only (CO). This paper compares the CSR duopoly outcomes with those of the CO duopoly.

The remainder of this paper is organised as follows. In Section 2, we describe the basic setting. Section 3 solves the two games. Finally, Section 4 concludes the paper.

2. Basic setting

There are two profit-maximising firms: firm 1 and firm 2. The firms produce complementary goods. Throughout this paper, the subscripts 1 and 2 represent firm 1 and firm 2, respectively. In addition, when i and j are used to refer to firms in an expression, they should be understood to refer to 1 and 2 with $i \neq j$. We do not consider the possibility of entry or exit. Our equilibrium concept is Nash's in pure strategies. There is a continuum of consumers of the same type, and the representative consumer maximises consumer surplus:

$$CS = U(q_1, q_2) - p_1 q_1 - p_2 q_2, \quad (1)$$

where q_i is the amount of good i and p_i is its price. The function $U(q_1, q_2)$ is quadratic: $U(q_1, q_2) = (q_1 + q_2) - \left(q_1^2 + q_2^2 - q_1 q_2\right)/2$. The inverse demand (price) function is given by $p_i = 1 - q_i + \delta q_j$, where $\delta \in (0,1)$ is a measure of the degree of complementarity among products. For the sake of simplicity, we assumed $\delta = 0.5$. Therefore, the firm i's profit is given by

$$\pi_i = q_i\left(1 - q_i + \frac{1}{2}q_j\right). \quad (2)$$

Firm i's corporate culture is either socially responsible, S, or customer oriented, C. Formally, CSR differs from CO in the objective function V_i: In addition to (2), the former contains (1), while the latter contains the surplus of firm i's own customers:

$$C_i = q_i - \frac{1}{2}\left(q_i^2 - q_i q_j\right) - q_i\left(1 - q_i + \frac{1}{2}q_j\right). \quad (3)$$

Hence,

$$V_i^S = \pi_i + \theta \cdot CS, \quad (4)$$

and

$$V_i^C = \pi_i + \theta \cdot C_i. \quad (5)$$

where $\theta \in [0,1]$ is the level of CSR (or CO). We assumed that the value of θ was given exogenously. Each firm simultaneously and independently chooses its output level in order to maximise its objective function.

3. Results

We considered the following two cases: two CSR firms and two CO firms.

3.1. Two CSR firms

Suppose that both firms consider the surplus of all consumers as their corporate culture. By differentiating (4) with respect to q_i, we obtain the firm i's best response function:

$$q_i(q_j) = \frac{2 + \left(1 - \theta^S\right) q_j}{2\left(2 - \theta^S\right)}. \tag{6}$$

Furthermore, inserting one reaction function into another, we obtain the Cournot-Nash equilibrium quantity of firm i:

$$q_i = \frac{2}{3 - \theta^S}. \tag{7}$$

Each firm anticipates these quantities and maximises the profit:

$$\pi_i^S = \left(1 - q_i + \frac{1}{2} q_j\right) q_i = \frac{2\left(2 - \theta^S\right)}{\left(3 - \theta^S\right)^2}. \tag{8}$$

The maximisation of (8) with respect to θ^S is derived from $d\pi_i^S / d\theta^S$. That is, $\theta^S = 1$, so that $\pi_i^S = 0.5$. π_i^S is illustrated in Figure 1 as a function of θ^S. When $0 \le \theta^S \le 1$, π_i^S is a strictly increasing function of θ^S.

3.2. Two CO firms

Next, suppose that both firms adopt CO as their corporate culture. By differentiating (4) with respect to q_i, we obtain firm i's best response function:

$$q_i(q_j) = \frac{2 + q_j}{2\left(2 - \theta^C\right)}. \tag{9}$$

We have the Cournot-Nash equilibrium quantity of firm *i*:

$$q_i = \frac{2}{3 - 2\theta^C}. \tag{10}$$

Each firm anticipates these quantities and maximises the profit:

$$\pi_i^C = \frac{4\left(1 - \theta^C\right)}{\left(3 - 2\theta^C\right)^2}. \tag{11}$$

The maximisation of (11) with respect to θ^C is derived from $d\pi_i^C / d\theta^C$. That is, $\theta^C = 0.5$, so that $\pi_i^C = 0.5$. π_i^C is illustrated in Figure 2 as a function of θ^C.

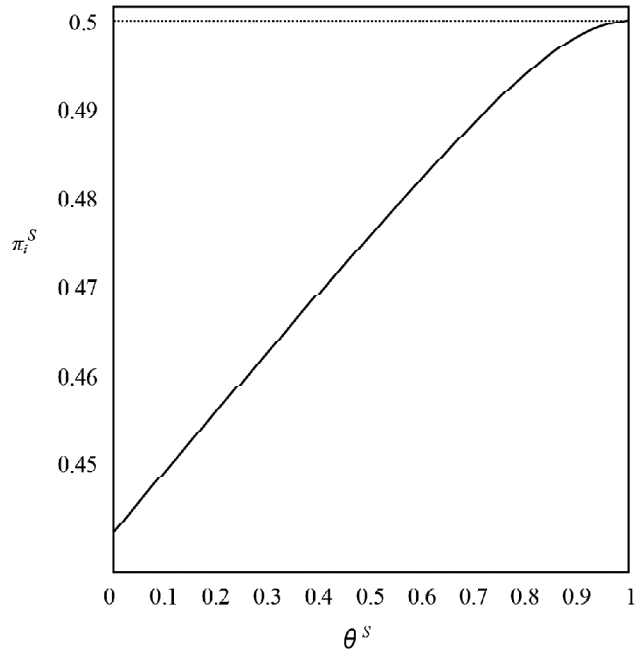

Figure 1: Two CSR firms

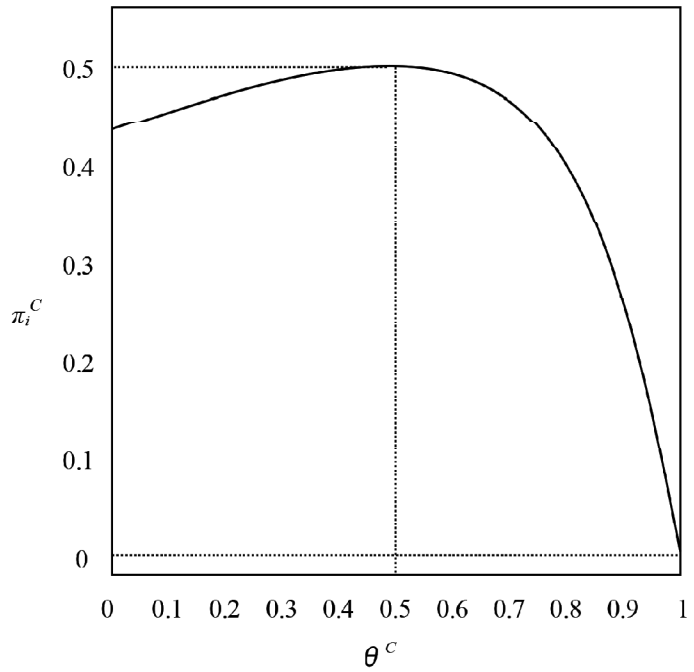

Figure 2: Two CO firms

3.3. Comparison

In this subsection, we compare the CSR duopoly outcomes with those of the CO duopoly. The optimal level of CSR is 1, and that of CO is 0.5. However, all the profits are 0.5. The result of this comparison is summarised in the following proposition.

Proposition 1: The optimal level of CSR in the CSR duopoly is different from that of CO in the CO duopoly, but all the profits at these optimal levels are the same.

4. Conclusion

We examined two games of Cournot duopoly in which two profit-maximising firms produced complementary goods. We showed that the profits at CSR duopoly equilibrium were the same as those at CO duopoly equilibrium. We examined one-shot games. However, in the real world, firms are generally faced with long-run competition. In the near future, we will examine various dynamic models consisting of CSR and CO firms.

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