

Price-setting hotel competition with corporate social responsibility

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Abstract

Pricing plays an important role in any market competition, but particularly in those businesses that hold a seat in hyper competitive economic activities such as hotels. This paper analyses a market competition between one corporate social responsibility (CSR) hotel and one for profit (FP) hotel, in which both hotels set room prices. We study three different market behaviors: (i) both hotels take their decisions simultaneously; (ii) the CSR hotel takes the leader position; (iii) the FP hotel takes the leader position. For each situation, by using game theory techniques, we compute the different outcomes of the model at equilibrium. We also describe the effects of CSR on the outcomes.

Keywords

Corporate social responsibility; Game Theory; hotel pricing strategies; different time of decisions; equilibrium

1. Introduction

How companies set prices depends on many reasons, with competition being one of the most decisive for choosing the pricing method. Many hotels consider themselves to be in direct competition with nearby hotels. A hotel's pricing strategy can therefore be based on a nearby competitor.

In this paper, we consider a duopoly composed by two hotels: one with corporate social responsibility (CSR) practices, and the other that only cares about its own profit. Both hotels set prices, and we analyse, separately, three cases: (i) both hotels take their decisions simultaneously; (ii) the CSR hotel takes the leader position; (iii) the for profit (FP) hotel takes the leader position.

In recent years, CSR has been addressed and managed by all types of companies and organizations in several ways. By practicing corporate social responsibility, companies can be conscious of the kind of impact they are having on all aspects of society, including economic, social, and environmental. The hospitality industry embraces different social issues and major hotel companies have implemented CSR initiatives related to environment preservation and community development. Investigating the strategic interaction between firms and customers in a dynamic

setting can generate valuable insights and explain market phenomena; and analyzing complicated network structures may reveal the link between competitive outcomes and social interactions (Chen and Chen 2021). This topic has received particular attention from several researchers (see, for instance, Chen and Nie (2016), Font and Lynes (2018), Wang et al. (2018), Chen et al. (2021)). Planer-Friedrich and Sahm (2021) examined the strategic use of CSR in Cournot competition between two firms that differ in their marginal costs of production. They show that the strategic use of CSR complements costs advantages and reinforces differences in market power.

As pointed out by Lewis (2021), “CSR is important in hospitality as it encourages organizations to do good within society, and further benefits them from a business point of view – think positive media attention, publicity and societal respect. The benefits of CSR policies in a business are far and wide – ranging from societal, economic and environmental. CSR is particularly important within hospitality as the industry as it has historically had a rather dramatic impact on the environment through energy and water consumption, food waste and the use of consumable goods – to name a few. The hotel sector alone currently accounts for around 1% of global carbon emissions, and this is only set to increase as the industry grows.”

Whilst there are a huge number of initiatives that hotels can undertake, most of them fit within a few broad categories (James 2018):

Social benefits – Hotels are able to contribute resources to the societies they serve through community development programs, encouraging diversity in the workplace, providing skill development programs and establishing progressive employment practices.

Environmental stewardship – Protecting local wildlife, the use of renewable materials in construction, wastewater management and locally grown ingredients in restaurants are just some of the ways that hotels and restaurants are able to flex their eco muscle and show their dedication to the environment.

Charitable giving – Being seen as a productive part of the community has significant benefits for organizations. McDonalds Ronald McDonald House has long been a place where families are able to find respite during times of illness. Many other companies make public donations to a variety of charities in line with their ethos and mission.” Nakamura (2013) compared the equilibrium social welfare between the quantity competition and the price competition in a duopoly with differentiated and substitutable goods composed of one CSR firm and one for profit firm. Xu (2014) investigated the impact of CSR on hospital duopoly with price and quality competition, by considering a CSR hospital as caring about not only the profit but also the patient benefit. Chen and Nie (2016) described the effects of CSR on food industry, under a two-stage duopoly model. They conclude that the CSR improves the quality and quantity of the food for CSR firm, while reduces the rival’s ones.

Wang et al. (2018) studied the effects of CSR practices under three different mixed duopolies: Cournot competition; Stackelberg competition with the CSR firm acting as the leader; and turnover, with the profit maximizing firm playing the lead position.

In this paper, we contribute to the development of the theory about CSR. We closely follow the model considered by Wang et al. (2018) but using prices instead of quantities as strategic variables.

The remainder of this paper is organized as follows. In Section 2, we describe the model. Section 3 develops the model with simultaneous decisions and the effects of social concerns. Sections 4 and 5 analyze the model with sequential decisions and the effects of social concerns. Finally, the conclusions are presented in Section 7.

2. The model

We consider a market with two hotels, which compete on prices (Bertrand competition). We assume that the representative consumer maximizes:

$$U(q_1, q_2) - p_1 q_1 - p_2 q_2,$$

where q_i is the quantity (occupancy rate) of hotel H_i and p_i is its price, with $i = 1, 2$. The function U is assumed to be quadratic, strictly concave, and symmetric in q_1 and q_2 :

$$U(q_1, q_2) = \alpha(q_1 + q_2) - \frac{1}{2}(q_1^2 + 2\gamma q_1 q_2 + q_2^2),$$

where $\alpha > 0$ indicates the total market size and $\gamma \in (0,1)$ is a measure of the degree of the differentiation of the hotels' rooms or services.

Assumption 1. For simplicity, we assume $\gamma = 0.5$.

So, the direct demand is characterized by

$$p_i = \alpha - q_i - \frac{1}{2}q_j,$$

where $i, j = 1, 2$ with $i \neq j$. Therefore, the direct demand is given by

$$q_i = \frac{2}{3}(\alpha - 2p_i + p_j).$$

For simplicity, we assume that both hotels have the same constant marginal cost c . We consider from now on prices net of marginal costs. This is without loss of generality since if marginal cost is positive, we may replace α by $\alpha - c$. The profit function π_i of hotel H_i is then

$$\begin{aligned} \pi_i &= (\alpha - q_i - \gamma q_j) q_i \\ &= \frac{2}{3}(\alpha - 2p_i + p_j) p_i, \end{aligned}$$

with $i, j = 1, 2$ and $i \neq j$.

The market we model is composed of 2 hotels: one FP hotel (H_1) and one CSR hotel (H_2). Following Lambertini and Tampieri (2010) and Wang et al. (2018), all social concerns are integrated as part of consumer surplus. Thus, the objective function of the CSR hotel is

$$V = \pi_2 + wCS,$$

where $w \in (0,1)$ is the weight that the CSR hotel assigns to the consumer surplus, and the consumer surplus CS is given by:

$$\begin{aligned} CS &= \frac{1}{2}(q_1^2 + q_1 q_2 + q_2^2) \\ &= \frac{2}{3}(p_1^2 - p_1 p_2 + p_2^2 + \alpha(\alpha - p_1 - p_2)). \end{aligned}$$

Assumption 2. In order to have interior solutions, we assume $0 < w < 10/11$.

The FP hotel H_1 aims to maximize its own profit π_1 .

Social welfare W is defined as the sum of hotels' profits and consumer surplus:

$$W = \pi_1 + \pi_2 + CS.$$

We will study and discuss three cases: (i) both hotels take their decisions simultaneously; (ii) the CSR hotel takes the leader position; (iii) the FP hotel takes the leader position.

3. Simultaneous decisions

In this section, we suppose that both hotels decide their room rates simultaneously.

The FP hotel H_1 solves the optimization problem $\max_{p_1} \pi_1$, and the CSR hotel H_2 solves the optimization problem

$\max_{p_2} V$. By solving the system:

$$\begin{cases} \frac{\partial \pi_1}{\partial p_1} = 0 \\ \frac{\partial V}{\partial p_2} = 0 \end{cases}$$

we get the Nash equilibrium¹:

$$p_1^S = \frac{\alpha(5-3w)}{15-7w} \quad \text{and} \quad p_2^S = \frac{5\alpha(1-w)}{15-7w}.$$

¹ Throughout the paper, we use the notation superscript S to refer the simultaneous decisions competition.

Thus, the resulting profits are:

$$\pi_1^S = \frac{4\alpha^2(5-3w)^2}{3(15-7w)^2} \text{ and } \pi_2^S = \frac{100\alpha^2(1-w)}{3(15-7w)^2}.$$

Therefore, the equilibrium consumer surplus and social welfare are given by:

$$CS^S = \frac{8\alpha^2(25-15w+3w^2)}{3(15-7w)^2} \text{ and } W^S = \frac{20\alpha^2(20-17w+3w^2)}{3(15-7w)^2}.$$

From

$$p_1^S - p_2^S = \frac{2\alpha w}{15-7w} \text{ and } \pi_1^S - \pi_2^S = -\frac{4\alpha^2 w(5-9w)}{3(15-7w)^2}$$

we conclude the following proposition.

Proposition 1. If both hotels decide, simultaneously, their room rates, then

- i) The room rate of the CSR hotel is lower than that of the FP hotel.
- ii) If the CSR hotel values little the consumer surplus ($0 < w < 5/9$), the CSR hotel's profit is higher than the FP hotel's profit.
- iii) If the CSR hotel greatly values the consumer's surplus ($5/9 < w < 10/11$), the CSR hotel's profit is lower than the FP hotel's profit.

3.1 Comparative static analysis

In this section, we evaluate the effect of the CSR hotel's preference for consumer surplus on the market equilibrium outputs. From

$$\begin{aligned} \frac{\partial p_1^S}{\partial w} &= -\frac{10\alpha}{(15-7w)^2} < 0, & \frac{\partial p_2^S}{\partial w} &= -\frac{40\alpha}{(15-7w)^2} < 0, \\ \frac{\partial \pi_1^S}{\partial w} &= -\frac{80\alpha^2}{3(15-7w)^3} < 0, & \frac{\partial \pi_2^S}{\partial w} &= -\frac{100\alpha^2(1+7w)}{3(15-7w)^3} < 0, \\ \frac{\partial CS^S}{\partial w} &= \frac{40\alpha^2(25-3w)}{3(15-7w)^3} > 0, & \frac{\partial W^S}{\partial w} &= \frac{20\alpha^2(25-29w)}{3(15-7w)^3} \begin{cases} > 0, \text{ if } 0 < w < 25/29 \\ < 0, \text{ if } 25/29 < w < 10/11 \end{cases} \end{aligned}$$

we conclude the following proposition.

Proposition 2. If both hotels decide, simultaneously, their room rates, then

- i) The prices set by both hotels decrease with the CSR hotel's preference for consumer surplus.
- ii) The profits of both hotels decrease with the CSR hotel's preference for consumer surplus.
- iii) The consumer surplus increases with the CSR hotel's preference for consumer surplus.
- iv) If the CSR hotel's preference for consumer surplus is small, it raises social welfare, while if the CSR hotel's preference for consumer surplus is large, it reduces social welfare.

3.2 Numerical example

Now, we present a numerical example for different values of the parameter w that represents the weight that the CSR hotel assigns to the consumer surplus: $w = 0.1$ and $w = 0.9$, by fixing $\alpha = 10$ (Table 1). This numerical example illustrates the results of this section.

Table 1. Numerical example for the results of simultaneous decisions

	$w = 0.1$	$w = 0.9$
p_1^S	3.287	2.644
p_2^S	3.147	0.575
$p_1^S - p_2^S$	0.140	2.069

π_1^S	14.403	9.319
π_2^S	14.671	4.404
$\pi_1^S - \pi_2^S$	-0.268	4.915
CS^S	30.684	49.077
W^S	59.758	62.800

4. CSR hotel acts as the leader

In this section, we consider the case in which the CSR hotel assumes a leading role, and the FP hotel responds. So, the model consists in the following two-stages game:

- In the first stage, the CSR hotel H_2 chooses its room rate p_2 ;
- Then, in the second stage, the FP hotel H_1 chooses its room rate p_1 .

The model is solved by backward induction to obtain the subgame perfect Nash equilibrium. In the second stage, the FP hotel H_1 chooses p_1 to maximize its own profit π_1 . Applying the first order optimal condition $\frac{\partial \pi_1}{\partial p_1} = 0$, we get

(1)

$$p_1 = \frac{\alpha + p_2}{4} \quad (1)$$

Putting (1) into the objective function V , the first order optimal condition $\frac{\partial V}{\partial p_2} = 0$ gives² (2)

$$p_2^L = \frac{\alpha(10 - 11w)}{28 - 13w}. \quad (2)$$

Now, putting (2) into (1), we obtain (3):

$$p_1^L = \frac{\alpha(19 - 12w)}{2(28 - 13w)} \quad (3)$$

Thus, the resulting profits of each hotel, consumer surplus and social welfare are given by:

$$\pi_1^L = \frac{\alpha^2(19 - 12w)^2}{3(28 - 13w)^2}, \quad \pi_2^L = \frac{\alpha^2(35 + 6w)(10 - 11w)}{3(28 - 13w)^2},$$

$$CS^L = \frac{\alpha^2(1333 - 672w + 156w^2)}{6(28 - 13w)^2} \quad \text{and} \quad W^L = \frac{\alpha^2(2755 - 2234w + 312w^2)}{6(28 - 13w)^2}.$$

From

$$p_1^L - p_2^L = -\frac{\alpha(1 - 10w)}{2(28 - 13w)} \begin{cases} < 0, & \text{if } 0 < w < 1/10 \\ > 0, & \text{if } 1/10 < w < 10/11 \end{cases}$$

and

$$\pi_1^L - \pi_2^L = \frac{\alpha^2(11 - 131w + 210w^2)}{3(28 - 13w)^2} \begin{cases} > 0, & \text{if } 0 < w < 1/10 \vee 11/21 < w < 10/11 \\ < 0, & \text{if } 1/10 < w < 11/21 \end{cases}$$

we conclude the following proposition.

Proposition 3. If the CSR hotel acts as a leader, then

- If the CSR hotel values little the consumer surplus ($0 < w < 1/10$), the room rate of the CSR hotel is higher than that of the FP hotel.

² Throughout the paper, we use the notation superscript L to refer the sequential decisions with the CSR hotel acting as the leader.

- ii) If the CSR hotel greatly values the consumer surplus ($1/10 < w < 10/11$), the room rate of the CSR hotel is lower than that of the FP hotel.
- iii) If the CSR hotel's preference for consumer surplus is either small or large ($0 < w < 1/10$ or $11/21 < w < 10/11$), the CSR hotel's profit is lower than the FP hotel's profit.
- iv) If the CSR hotel's preference for consumer surplus belongs to an intermediate region ($1/10 < w < 11/21$), the CSR hotel's profit is higher than the FP hotel's profit.

4.1 Comparative static analysis

In this section, we evaluate the effect of the CSR hotel's preference for consumer surplus on the market equilibrium outputs. From

$$\frac{\partial p_1^L}{\partial w} = -\frac{89\alpha}{2(28-13w)^2} < 0, \quad \frac{\partial p_2^L}{\partial w} = -\frac{178\alpha}{(28-13w)^2} < 0,$$

$$\frac{\partial \pi_1^L}{\partial w} = -\frac{178\alpha^2(19-12w)}{3(28-13w)^3} < 0, \quad \frac{\partial \pi_2^L}{\partial w} = -\frac{7921\alpha^2 w}{3(28-13w)^3} < 0$$

$$\frac{\partial CS^L}{\partial w} = \frac{7921\alpha^2}{3(28-13w)^3} > 0, \quad \frac{\partial W^L}{\partial w} = \frac{89\alpha^2(51-65w)}{3(28-13w)^3} \begin{cases} < 0, & \text{if } 0 < w < 51/65 \\ > 0, & \text{if } 51/65 < w < 10/11 \end{cases}$$

we conclude the following proposition.

Proposition 4. If the CSR hotel acts as a leader, then

- i) The prices set by both hotels decrease with the CSR hotel's preference for consumer surplus.
- ii) The profits of both hotels decrease with the CSR hotel's preference for consumer surplus.
- iii) The consumer surplus increases with the CSR hotel's preference for consumer surplus.
- iv) If the CSR hotel's preference for consumer surplus is low, it reduces social welfare, while if the CSR hotel's preference for consumer surplus is high, it raises social welfare.

4.2 Numerical example

Now, we present a numerical example for different values of the parameter w that represents the weight that the CSR hotel assigns to the consumer surplus: $w = 0.1$ and $w = 0.9$, by fixing $\alpha = 10$ (Table 2). This numerical example illustrates the results of this section.

Table 2. Numerical example for the results of CSR hotel acting as the leader

	$w = 0.1$	$w = 0.9$
p_1^L	3.333	2.515
p_2^L	3.333	0.061
$p_1^L - p_2^L$	0	2.454
π_1^L	14.815	8.436
π_2^L	14.815	0.507
$\pi_1^L - \pi_2^L$	0	7.929
CS^L	29.630	53.606
W^L	59.259	62.549

5. FP hotel acts as the leader

In this section, we consider the case in which the FP hotel assumes a leading role, and the CSR hotel responds. So, the model consists in the following two-stages game:

- In the first stage, the FP hotel H_1 chooses its room rate p_1 ;
- Then, in the second stage, the CSR hotel H_2 chooses its room rate p_2 .

The model is solved by backward induction to obtain the subgame perfect Nash equilibrium. In the second stage, the CSR hotel H_2 chooses p_2 to maximize its objective function V . Applying the first order optimal condition $\frac{\partial V}{\partial p_2} = 0$, we get (4)

$$p_2 = \frac{(\alpha + p_1)(1-w)}{2(2-w)} \quad (4)$$

Putting (3) into the profit function π_1 of the FP hotel, the first order optimal condition $\frac{\partial \pi_1}{\partial p_1} = 0$ gives³ (5):

$$p_1^F = \frac{\alpha(5-3w)}{2(7-3w)}. \quad (5)$$

Now, putting (5) into (4), we obtain

$$p_2^F = \frac{\alpha(1-w)(19-9w)}{4(2-w)(7-3w)}.$$

Thus, the resulting profits of each hotel, consumer surplus and social welfare are given by:

$$\begin{aligned} \pi_1^F &= \frac{\alpha^2(5-3w)^2}{12(2-w)(7-3w)}, & \pi_2^F &= \frac{\alpha^2(1-w)(19-9w)^2}{12(2-w)^2(7-3w)^2}, \\ CS^F &= \frac{\alpha^2(1333-1962w+1080w^2-270w^3+27w^4)}{24(2-w)^2(7-3w)^2}, \\ W^F &= \frac{\alpha^2(2755-4858w+3108w^2-846w^3+81w^4)}{24(2-w)^2(7-3w)^2}. \end{aligned}$$

From

$$p_1^F - p_2^F = \frac{\alpha(1+6w-3w^2)}{4(2-w)(7-3w)} > 0$$

and

$$\pi_1^F - \pi_2^F = -\frac{\alpha^2(11+42w-168w^2+126w^3-27w^4)}{12(2-w)^2(7-3w)^2} \begin{cases} < 0, & \text{if } 0 < w < (4-\sqrt{5})/3 \\ > 0, & \text{if } (4-\sqrt{5})/3 < w < 10/11 \end{cases}$$

we conclude the following proposition.

Proposition 5. If the CSR hotel acts as a follower, then

- i) The room rate of the CSR hotel is lower than that of the FP hotel.
- ii) If the CSR hotel values little the consumer surplus ($0 < w < (4-\sqrt{5})/3$), the CSR hotel's profit is higher than the FP hotel's profit.
- iii) If the CSR hotel greatly values the consumer's surplus ($(4-\sqrt{5})/3 < w < 10/11$), the CSR hotel's profit is lower than the FP hotel's profit.

5.1 Comparative static analysis

In this section, we evaluate the effect of the CSR hotel's preference for consumer surplus on the market equilibrium outputs. From

$$\frac{\partial p_1^F}{\partial w} = -\frac{3\alpha}{(7-13w)^2} < 0, \quad \frac{\partial p_2^F}{\partial w} = -\frac{\alpha(145-138w+33w^2)}{4(2-w)^2(7-3w)^2} < 0,$$

³ Throughout the paper, we use the notation superscript F to refer the sequential decisions with the CSR hotel acting as a follower.

$$\frac{\partial \pi_1^F}{\partial w} = -\frac{\alpha(5-3w)(19-9w)}{12(2-w)^2(7-3w)^2} < 0, \quad \frac{\partial \pi_2^F}{\partial w} = -\frac{\alpha^2(19-9w)(24+97w-108w^2+27w^3)}{12(2-w)^2(7-3w)^2} < 0,$$

$$\frac{\partial CS^F}{\partial w} = \frac{\alpha^2(3595-5631w+3159w^2-729w^3+54w^4)}{12(2-w)^3(7-3w)^3} > 0,$$

$$\frac{\partial W^F}{\partial w} = \frac{\alpha^2(1809-4595w+4095w^2-1557w^3+216w^4)}{12(2-w)^3(7-3w)^3} \begin{cases} > 0, \text{ if } 0 < w < w_0 \\ < 0, \text{ if } w_0 < w < 10/11, \end{cases}$$

where $w_0 \in (0.89, 0.90)$ is such that $1809 - 4595w_0 + 4095w_0^2 - 1557w_0^3 + 216w_0^4 = 0$, we conclude the following proposition.

Proposition 6. If the CSR hotel acts as a follower, then

- i) The prices set by both hotels decrease with the CSR hotel's preference for consumer surplus.
- ii) The profits of both hotels decrease with the CSR hotel's preference for consumer surplus.
- iii) The consumer surplus increases with the CSR hotel's preference for consumer surplus.
- iv) If the CSR hotel's preference for consumer surplus is low, it raises social welfare, while if the CSR hotel's preference for consumer surplus is high, it reduces social welfare.

5.2 Numerical example

Now, we present a numerical example for different values of the parameter w that represents the weight that the CSR hotel assigns to the consumer surplus: $w = 0.1$ and $w = 0.9$, by fixing $\alpha = 10$ (Table 3). This numerical example illustrates the results of this section.

Table 3. Numerical example for the results of FP hotel acting as the leader

	$w = 0.1$	$w = 0.9$
p_1^F	3.507	2.674
p_2^F	3.199	0.576
$p_1^F - p_2^F$	0.308	2.098
π_1^F	14.461	9.320
π_2^F	15.162	4.425
$\pi_1^F - \pi_2^F$	-0.701	4.895
CS^F	29.500	48.959
W^F	59.123	62.704

7. Conclusions

This paper developed the theory of CSR on hotel industry in a price-setting market with two hotels such that just one of them has social concerns in its economic operation. We analyzed three different strategic models, related to the timing of decisions.

When the two hotels decide simultaneously, the CSR hotel sets a lower price than the FP hotel. Furthermore, when the CSR hotel's preference for consumer surplus is small (resp., large), CSR hotel earns higher (resp., lower) profits than the FP hotel.

If the CSR hotel sets the price before the FP hotel, it will be at an advantage, in the sense that it achieves higher profits, when the CSR hotel's preference for consumer surplus is neither too large nor too small; and it will be at a disadvantage, when the CSR hotel's preference for consumer surplus is either small or large.

If the CSR hotel sets the price after the FP hotel, it will be at an advantage, in the sense that it achieves higher profits, when the CSR hotel's preference for consumer surplus is small; and it will be at a disadvantage, when the CSR hotel's preference for consumer surplus is large.

In the three cases considered, we showed that CSR hotel's preference for consumer surplus raises (reduces) social welfare, if the CSR hotel's preference for consumer surplus is small (resp., large).

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Biographies

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