

Sustainability and hotel room pricing strategies

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Abstract | Social welfare in the hospitality industry refers to the overarching efforts and initiatives aimed at promoting the well-being and satisfaction of various stakeholders within the sector. This includes not only guests but also employees, local communities, and the environment. In this paper, we consider two different economic models in the hospitality industry, where one consumer-friendly hotel competes with a for-profit hotel taking decisions on environmental corporate social responsibility and on room rates. Hotels choose environmental corporate social responsibility investments sequentially, and room rates simultaneously. We analyse the impact of their decisions on the social welfare and hotel room pricing strategies and we also do a comparison between the results obtained in both models.

Keywords | sustainable tourism, hotel pricing strategies, social welfare

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1. Introduction

In theory, we can say that sustainability and hotel room pricing strategies are closely interconnected. By adopting sustainable practices, hotels can justify premium pricing, attract environmentally conscious guests, improve operational efficiencies and enhance the overall guest experience. These factors allow hotels to implement a variety of pricing strategies that highlight the added value of sustainability, appeal to different market segments, and sustain their competitiveness in the hospitality industry. However, as it is well-known, the complexity of revenue management in the hospitality industry arises from the necessity to simultaneously balance numerous dynamic factors. Effective revenue management requires a sophisticated approach that integrates data analysis, market segmentation, inventory control, technological tools, and an understanding of external influences. By navigating these complexities, hotels can optimize their pricing strategies to maximize revenue, cater to diverse customer needs, and remain competitive in an ever-changing market. In this paper, we only intend to contribute to the problem of the relationship between sustainability and pricing strategy in the hotel industry.

Corporate Social Responsibility (CSR) can make a significant contribution to a responsible and sustainable development of tourism. According to the definition of the European Commission (CEC, 2001), CSR is a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis. We point out that CSR measures are voluntary and should therefore exceed legal regulations.

CSR was first implemented in the tourism sector in the late 1990s by international hotel corporations. The literature on CSR has grown appreciably in recent years (e.g., Kaur, Talwar, Madanaguli, Srivastava & Dhir, 2022). As mentioned in CityDNA (2022), many international hotel chains have integrated CSR measures, such as Marriott International with the program “Spirit to Serve Our Communities” or NH Hoteles’ “Street Children”. Today, many hotel chains publish annual CSR reports on their websites (e.g., Accor, Hilton Hotel Corporation, Inter-Continental Hotels, NH Hoteles, Club Méditerranée, ...).

The hospitality industry can have significant environmental impacts due to energy consumption, water usage, waste generation, and transportation (TheInsider, 2023). Social welfare initiatives in this realm focus on minimizing these negative effects through

sustainable practices such as energy and water conservation, waste reduction and recycling, green building design, and promoting eco-friendly transportation options.

Environmental corporate social responsibility (ECSR) refers to the conscientious and voluntary actions that corporations undertake to mitigate their environmental footprint and promote sustainability. It entails incorporating environmentally sustainable practices and strategies into fundamental business operations, with an emphasis on minimizing greenhouse gas emissions, preserving natural resources, and managing environmental risks. With consumers, investors, and stakeholders increasingly seeking greater accountability from companies, ECSR has emerged as a crucial component of a firm's reputation and competitive edge (e.g., Agudelo, Jóhannsdóttir & Davídsdóttir, 2019).

In this paper, we investigate a Bertrand competition after hotels choose, sequentially, whether to adopt ECSR. We recall that a Bertrand competition is a model in economic theory that describes an oligopolistic market structure where firms compete by setting prices. So, we consider a market with one consumer-friendly (CF) hotel and one for-profit (FP) hotel. By a CF hotel, we mean a hotel that not only cares about maximizing its profit, but also cares about social well-being. Furthermore, we analyse two scenarios: (i) where the CF hotel assumes the leadership position, and (ii) where the FP hotel takes on the role of leader. The results show that the adoption of ECSR practices can either enhance or deteriorate social welfare, contingent upon variables such as the extent of pollution emitted by hotels. Therefore, our study contributes to the problem of the relationship between sustainability and hotel room pricing strategies.

The remained of the paper is organized as follows. In Section 2, we present the theoretical framework including a review of the literature. Then, we describe the model in Section 3. In Sections 4 and 5 we study the two different cases that are considering in the paper. In Section 6 we compare social welfare for each case studied. Conclusions are presented in Section 7.

2. Theoretical framework

Sustainability in the hospitality industry encompasses environmental, social, and economic dimensions. Environmental sustainability involves reducing energy consumption, minimizing waste generation, conserving water resources, and adopting eco-friendly practices (Li, Ahmad, Ayassrah, Irshad, Telba, Awwad & Majid, 2023). Social sustainability focuses on supporting local communities, ensuring fair labor practices, and promoting cultural heritage

preservation. Economic sustainability entails maximizing profitability while balancing long-term growth with the well-being of stakeholders (e.g., Alsayegh, Rahman & Homayoun, 2020).

A corporate culture centered around social responsibility entails actively contributing to the welfare of the community. This is accomplished by conducting business in a manner that creates shared value for society through ethical practices, as emphasized in research such as that conducted by Agudelo et al. (2019) and by Sharma (2019). This can be achieved through specific policies that prioritize social responsibility (Chaffee, 2017). Implementing CSR initiatives opens opportunities to achieve sustainability, create value, and gain a competitive advantage (Bohdanowicz & Zientara, 2021; Cheng & Ding, 2021). Realizing this, hospitality enterprises are increasingly allocating resources to CSR endeavours, aiming to foster strong stakeholder connections and improve their operational performance (Ghaderi, Mirzapour, Henderson & Richardson, 2019; Franco, Caroli, Cappa & Del Chiappa, 2020).

The adoption of environmentally conscious CSR initiatives directly influences the commitment and esteem towards the tourism sector, as evidenced by research conducted by Bogan & Dedeoglu (2019) and Han, Yu & Kim (2019). Essentially, these initiatives contribute to the progression of corporate sustainability, fostering the comprehensive well-being of society across social, economic, and environmental dimensions, both currently and in the future. This facilitates the movement towards more resilient communities and improved well-being, in accordance with the notion of sustainable living (Biswas, 2020).

Environmental sustainability initiatives in the hospitality industry have direct and indirect impacts on social welfare. By reducing resource consumption and minimizing pollution, hotels contribute to environmental preservation, which benefits local communities and ecosystems. Sustainable sourcing practices support local suppliers and farmers, stimulating economic development and enhancing community resilience. Energy-efficient technologies and waste reduction programs can lead to cost savings, which can be reinvested in employee training, benefits, and welfare programs, improving employee satisfaction and retention. Moreover, environmentally conscious practices enhance brand reputation and attract socially responsible guests, leading to increased occupancy rates and revenue generation (e.g., Popşa, 2023; Schafer, 2023).

In the hospitality sector, integrating the "3Rs" (reduce, reuse, and recycle) into the environmental strategy occupies a pivotal role for companies. Researchers like Chen & Peng

(2016) and Ioannidis, Chalvatzis, Leonidou & Feng (2021) have underscored this point. Regarding the assessment of sustainable performance metrics in the hospitality sector, Franzoni, Sarwar & Ishaq (2021) concentrate on environmental factors. They emphasize the subsequent indicators: Carbon dioxide (CO₂) emissions; Energy consumption per guest night; Renewable energy generation; Water consumption; Plastic usage; Environmental certification; Use of certified eco-friendly cleaning products. As noted by Lewis (2021), within the hospitality sector, CSR gains significance by inspiring organizations to make positive contributions to society. This not only generates favourable outcomes from a business standpoint but also results in advantages such as positive media coverage, improved publicity, and heightened societal reputation.

Previous research suggests that an increasing number of travellers are willing to pay a premium for environmentally and socially responsible accommodations. Effective communication of sustainability initiatives and their benefits to guests can enhance perceived value and justify higher room rates (e.g., Kang & Nicholls, 2021).

Ferreira et al. (2022b) 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. They analysed three different strategic models, related to the timing of decisions, and they showed that, in all those cases, CSR hotel's preference for consumer surplus raises (reduces) social welfare, if the CSR hotel's preference for consumer surplus is small (resp., large). Ferreira et al. (2022a) studied the effects of CSR on the strategic choice of pollution reduction and on the timing of the government's commitment to the environmental tax policy, in the hospitality industry. Hirose et al. (2017) consider a model in which two firms choose whether to adopt environmental corporate social responsibility (ECSR) policies and then face a sequential price-setting competition. Ferreira et al. (2024) applied the model used in (Hirose et al., 2017) to the hospitality industry, with one consumer-friendly (CF) hotel and one for-profit (FP) hotel, instead of two private companies, and they studied the model in which both hotels choose, simultaneously, the levels of adoption of ECSR, and then face a sequential price-setting competition. In this paper, we model a market competition between one CF hotel and one FP hotel, in which both hotels choose, sequentially, the levels of adoption of ECSR, and then set, simultaneously, the room rates.

3. Methods

To conduct our research, we used a game theoretical model embedded in the decision-making process. It consists of a situation in which different actors act in their own interest to maximize profit and the payoff is a function of all players acting together. Game theory is a mathematical framework used to analyse strategic interactions between different individuals or entities. Game theory is widely used in economics to study market behaviour, competition, auctions, pricing strategies, and contract design (Gibbons, 1992).

We establish a market competition between one consumer-friendly (CF) hotel H_1 and one for-profit (FP) hotel H_2 . The owners of the CF hotel aim to maximize social welfare, whereas the owners of the FP hotel aim to maximize its own profit. Furthermore, the owners of each hotel commit to donating a monetary amount for environmental improvements. However, each hotel has a manager who decides the room rates that maximizes its net profit (the profit after subtracting the cost of donation).

We assume that the representative consumer maximizes $U(q_1, q_2) - p_1q_1 - p_2q_2$, where q_i is the quantity (occupancy) of hotel H_i and p_i is its price (room rate), with $i = 1, 2$. The function U is assumed to be quadratic, strictly concave, and symmetric in q_1 and q_2 :

$$U(q_1, q_2) = \alpha(q_1 + q_2) - \frac{1}{2}(q_1^2 + 2\gamma q_1q_2 + q_2^2),$$

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. For simplicity, we assume $\gamma = 0.5$. So, the inverse 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

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

The common marginal cost is assumed to be constant and normalized to zero. Hotel H_i 's profit π_i is given by $\pi_i = p_i q_i$.

The owners of hotel H_1 's payoff is $\pi_1 = p_1 q_1$, the owners of hotel H_2 's payoff is social welfare (hotels' profits plus consumer surplus minus the loss from the externalities), and management's payoff is

$$V_i = \pi_i - \theta_i \beta q_i,$$

where βq_i is the level of pollution emitted by hotel H_i , and $\theta_i \geq 0$ is an internal emission price, representing the degree of environmental CSR and determined by the owners of hotel H_i . Social welfare W is defined by

$$W = \pi_1 + \pi_2 + CS - \beta(q_1 + q_2),$$

where consumer surplus CS is given by

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

We will study and discuss two cases:

- A. The CF hotel takes the leader position;
- B. The FP hotel takes the leader position.

The proposed methodology consists in modelling the non-cooperative competition using game theory concepts.

In each case, the model is a three-stage game.

In the first case (Case A), the game runs as follows:

- (i) In the first stage, CF hotel sets the degree of ECSR;
- (ii) In the second stage, FP hotel sets the degree of ECSR;
- (iii) In the third stage, both hotels choose, simultaneously, their respective room rates.

In the second case (Case B), the game runs as follows:

- (i) In the first stage, FP hotel sets the degree of ECSR;
- (ii) In the second stage, CF hotel sets the degree of ECSR;
- (iii) In the third stage, both hotels choose, simultaneously, their respective room rates.

4. CF hotel acts as the leader

In this section, we study the following three-stage model:

- (i) In the first stage, CF hotel H_1 sets the degree of ECSR θ_1 ;
- (ii) In the second stage, FP hotel H_2 sets the degree of ECSR θ_2 ;
- (iii) In the third stage, both hotels choose, simultaneously, their respective room rates p_1 and p_2 .

Assumption 1. In this section, and in order to have interior solutions, we assume

$$\frac{177}{532}\alpha < \beta < \frac{2}{3}\alpha.$$

The model is solved by backward induction to obtain the subgame perfect Nash equilibrium. In the third stage, both hotels decide their room rates simultaneously. The manager of hotel H_i solves the optimization problem $\max_{p_i} V_i$. By solving the system

$$\begin{cases} \frac{\partial V_1}{\partial p_1} = 0 \\ \frac{\partial V_2}{\partial p_2} = 0 \end{cases}$$

we get the Nash equilibrium:

$$p_1 = \frac{5\alpha + 2\beta(4\theta_1 + \theta_2)}{15} \text{ and } p_2 = \frac{5\alpha + 2\beta(\theta_1 + 4\theta_2)}{15}.$$

Thus, the resulting profits and social welfare are

$$\pi_1 = \frac{4(5\alpha + 2\beta(4\theta_1 + \theta_2))(5\alpha + \beta(2\theta_2 - 7\theta_1))}{675}, \quad (1)$$

$$\pi_2 = \frac{4(5\alpha + 2\beta(\theta_1 + 4\theta_2))(5\alpha + \beta(2\theta_1 - 7\theta_2))}{675}, \quad (2)$$

$$W = \frac{4(100\alpha^2 + 25\alpha\beta(\theta_1 + \theta_2 + 6) - \beta^2(26\theta_1^2 - \theta_1(2\theta_2 + 75) + \theta_2(26\theta_2 - 75)))}{675}. \quad (3)$$

In the second stage, FP hotel H_2 sets the degree of ECSR θ_2 that maximizes its own profit π_2 .

By solving $\partial\pi_2 / \partial\theta_2 = 0$, we get

$$\theta_2 = \frac{5\alpha + 2\beta\theta_1}{112\beta}. \quad (4)$$

Now, in the first stage, putting (4) into W defined by (3), and solving $\partial W / \partial \theta_1 = 0$, we obtain, successively, the perfect Nash equilibrium⁴:

$$\theta_1^A = \frac{52\beta - 177\alpha}{362\beta},$$

$$\theta_2^A = \frac{19\beta + 26\alpha}{724\beta},$$

$$p_1^A = \frac{285\beta + 28\alpha}{362}, \quad p_2^A = \frac{2(19\beta + 26\alpha)}{181}.$$

The resulting profits and social welfare are

$$\pi_1^A = \frac{(28\alpha + 285\beta)(205\alpha - 247\beta)}{98283}, \quad \pi_2^A = \frac{14(26\alpha + 19\beta)^2}{98283},$$

$$W^A = \frac{676\alpha^2 - 118\alpha\beta + 361\beta^2}{1086}.$$

It is easy to see that

$$\pi_1^A - \pi_2^A \begin{cases} > 0, & \frac{177}{532}\alpha < \beta < \frac{4}{11}\alpha \\ < 0, & \frac{4}{11}\alpha < \beta < \frac{2}{3}\alpha \end{cases}$$

So, we obtain the following result.

Proposition 1. If the CF hotel assumes a leader position, then

- i) for low factors of the levels of pollution emitted by the hotels, there exists an advantage for the CF leader hotel;
- ii) for high factors of the levels of pollution emitted by the hotels, there exists an advantage for the FP follower hotel.

⁴ Throughout the paper, we use the notation superscript A to refer the Case A: CF hotel takes the leader position.

Thus, we can say that, in a situation where hotels are emitting minimal pollution, being the pioneer in implementing certain measures or enacting specific changes can yield a competitive advantage or benefit. In scenarios where hotels are producing considerable pollution, there exists a strategic advantage for a business or entity that delays its response or action in addressing the pollution matter, rather than being the first to take the initiative.

Let us now look at the potential impacts of ECSR measures on the social welfare. We observe that without ECSR, social welfare $W^{A,N}$ is given by

$$W^{A,N} = \frac{8\alpha(2\alpha - 3\beta)}{27}.$$

We obtain

$$W^A - W^{A,N} \begin{cases} > 0, & \frac{328 + 2\sqrt{543}}{1083} \alpha < \beta < \frac{2}{3} \alpha \\ < 0, & \frac{177}{532} \alpha < \beta < \frac{328 + 2\sqrt{543}}{1083} \alpha \end{cases}$$

This leads to the following proposition.

Proposition 2. If the CF hotel assumes a leader position, then both hotels adopt ECSR. then

- i) for low factors of the levels of pollution emitted by the hotels, ECSR worsen social welfare;
- ii) for high factors of the levels of pollution emitted by the hotels, ECSR improves social welfare.

When the levels of pollution emitted by the hotels are relatively low, the implementation of ECSR practices may worsen social welfare. This could happen because the environmental improvements achieved by ECSR might be marginal when starting from a low pollution baseline. As a result, the social and environmental benefits might not justify the costs incurred. Conversely, when the levels of pollution emitted by the hotels are high, the implementation of ECSR practices can significantly improve social welfare. This could happen because In high pollution scenarios, the benefits of reducing pollution through ECSR are likely to be much greater, justifying the investment costs. The improvements in environmental quality can lead to long-term economic and social benefits that outweigh the initial expenditures.

5. FP hotel acts as the leader

In this section, we study the following three-stage model:

- (i) In the first stage, FP hotel H_2 sets the degree of ECSR θ_2 ;
- (ii) In the second stage, CF hotel H_1 sets the degree of ECSR θ_1 ;
- (iii) In the third stage, both hotels choose, simultaneously, their respective room rates p_1 and p_2 .

Assumption 2. In this section, and in order to have interior solutions, we assume $\frac{161}{485}\alpha < \beta < \frac{2}{3}\alpha$.

The model is solved by backward induction to obtain the subgame perfect Nash equilibrium. In the third stage, both hotels decide their room rates simultaneously, and the situation is exactly the same as in the previous section.

In the second stage, CF hotel H_1 sets the degree of ECSR θ_1 that maximizes social welfare W . By solving $\partial W / \partial \theta_1 = 0$, we get

$$\theta_1 = \frac{(75 + 2\theta_2)\beta - 25\alpha}{52\beta}. \quad (5)$$

Now, in the first stage, putting (5) into π_2 defined by (2), and solving $\partial \pi_2 / \partial \theta_2 = 0$, we obtain, successively, the perfect Nash equilibrium⁵:

$$\begin{aligned} \theta_2^B &= \frac{5\beta + 7\alpha}{168\beta}, \\ \theta_1^B &= \frac{485\beta - 161\alpha}{336\beta}, \\ p_1^B &= \frac{65\beta + 7\alpha}{84}, \quad p_2^B = \frac{5\beta + 7\alpha}{24}. \end{aligned}$$

The resulting profits and social welfare are

$$\begin{aligned} \pi_1^B &= \frac{(7\alpha + 65\beta)(21\alpha - 25\beta)}{2352}, \quad \pi_2^B = \frac{(7\alpha + 5\beta)^2}{504}, \\ W^B &= \frac{8771\alpha^2 - 15358\alpha\beta + 4715\beta^2}{14112}. \end{aligned}$$

⁵ Throughout the paper, we use the notation superscript B to refer the Case B: FP hotel takes the leader position.

It is easy to see that

$$\pi_1^B - \pi_2^B \begin{cases} > 0, & \frac{161}{485}\alpha < \beta < \frac{7}{19}\alpha \\ < 0, & \frac{7}{19}\alpha < \beta < \frac{2}{3}\alpha \end{cases}$$

So, we obtain the following result.

Proposition 3. If the FP hotel assumes a leader position, then

- i) for low factors of the levels of pollution emitted by the hotels, there exists an advantage for the CF follower hotel;
- ii) for high factors of the levels of pollution emitted by the hotels, there exists an advantage for the FP leader hotel.

Thus, we can say that, in a situation where hotels are emitting minimal pollution, there's a strategic advantage for a business or entity to delay their response or action in addressing the pollution issue, rather than being the first to act; In scenarios where hotels are producing considerable pollution, being the pioneer in implementing certain actions or making specific changes can offer a competitive edge or advantage.

Let us now look at the potential impacts of ECSR measures on the social welfare. We observe that without ECSR, social welfare $W^{B,N}$ is given by

$$W^{B,N} = \frac{8\alpha(2\alpha - 3\beta)}{27}.$$

We obtain

$$W^B - W^{B,N} \begin{cases} > 0, & \frac{4221 + 112\sqrt{39}}{14145}\alpha < \beta < \frac{2}{3}\alpha \\ < 0, & \frac{161}{485}\alpha < \beta < \frac{4221 + 112\sqrt{39}}{14145}\alpha \end{cases}$$

This leads to the following proposition.

Proposition 4. If the FP hotel assumes a leader position, then

- i) for low factors of the levels of pollution emitted by the hotels, ECSR worsen social welfare;
- ii) for high factors of the levels of pollution emitted by the hotels, ECSR improves social welfare.

The explanation of this result is the same as that previously presented for Proposition 2.

6. Comparison

Finally, in this section, we compare some results obtained for each model presented above.

Assumption 3. In this section, we assume $\frac{177}{532}\alpha < \beta < \frac{2}{3}\alpha$.

We highlight that:

Proposition 5. In both models considered, both CF and FP hotels adopt ECSR.

Now, we compare the levels of social welfare obtained in each model studied above. From

$$W^B - W^A \begin{cases} > 0, & \frac{84\sqrt{2353} - 2485}{4343}\alpha < \beta < \frac{2}{3}\alpha \\ < 0, & \frac{177}{532}\alpha < \beta < \frac{84\sqrt{2353} - 2485}{4343}\alpha \end{cases}$$

we can establish the following result:

Proposition 6.

- i) For low factors of the levels of pollution emitted by the hotels, the level of social welfare is higher in the case of CF hotel acting as the leader than in the opposite case;
- ii) For high factors of the levels of pollution emitted by the hotels, the level of social welfare is higher in the case of FP hotel acting as the leader than in the opposite case.

7. Conclusion

Environmental sustainability initiatives in the hospitality industry have significant implications for social welfare, encompassing community well-being, employee welfare, and guest satisfaction. By integrating environmental considerations into business strategies and fostering stakeholder collaboration, hotels can achieve a balance between environmental stewardship and social responsibility, contributing to a more sustainable and inclusive hospitality sector. Continued research, innovation, and collective action are essential for advancing environmental sustainability and social welfare goals and addressing global challenges such as climate change, biodiversity loss, and social inequality.

In this paper, we examined a framework where both consumer-friendly (CF) and for-profit (FP) hotels sequentially make decisions regarding the implementation of environmental corporate social responsibility. Subsequently, they engage in simultaneously competition within a context of price competition. We analysed two scenarios: (i) where the CF hotel assumes the leadership position, and (ii) where the FP hotel takes on the role of leader.

The findings enable us to deduce that, in the two models considered, the implementation of ECSR practices can improve or worsen social welfare, depending on the factors of the levels of pollution emitted by the hotels. This highlights the nuanced relationship between ECSR practices, levels of pollution, and their collective impact on social welfare, emphasizing the importance of context-specific approaches to corporate sustainability.

In short, we conclude that the adoption of sustainability practices has implications for the prices charged by hotels, and for the social well-being of the populations.

Acknowledgements

This work was supported by national funds through FCT/MCTES (PIDDAC): UNIAG, UIDB/04752/2020 (DOI 10.54499/UIDB/04752/2020) and UIDP/04752/2020 (DOI 10.54499/UIDP/04752/2020).

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