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In this short paper we analyze the impact of tourist demand in hotel rooms on the investment of hotels on environmental quality. We show that when income of the tourists increases, then to maintain the demand for rooms, the hotels must increase the investment on the environmental quality of the region where there is an increment of the tourist activity. In the particular case where we have three different hotel chains located in three different tourist regions, we show that the incentive of hotel chains to invest in environmental quality depends on the demand for days of rest on the part of tourists and on the level of aggregate income. We also show that if total income increase, then the incentive to invest in environmental quality increases in the region where the price of a hotel room is lower.

Keywords: *environmental investment, hotelling competition, service quality, sustainable tourism*

INTRODUCTION

The conservation of the environment constitutes a main concern of tourism operators. As a service industry, tourism affects directly the environment and then the tourist sector and policy makers are interested in

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investing in environmental quality and in a sustainable utilization of the local natural and man made resources∗. An important characteristic of the tourist industry is that the activities of a specific tourist firm (for example, a hotel, a resort, a bar located in a beach, etc) affect directly the environment and the quality of the region in which it is located. And conversely, the environmental quality of a zone in part determines the demand for tourist services. Then there are externalities across tourist firms owners in a specific region. Obviously the impact of one hotel on the environment has consequences for the perceived quality of all the hotels in the area. Thus externalities across hotel establishments constitute a key factor in understanding the industry. The presence of these externalities creates a commons problem: quality is jointly produced by all hotels in the region.

The tourist industry involves two main activities, namely: accomodation and transportation. In this paper we focus on the accommodation sector to study its impact on the environment. The tourist sector has an increasing economic importance and in particular, the hotel industry is in increasing international expansion. In addition to safety, hygiene, relaxation and comfort, one of the most important qualities that a good hotel must offer to the tourist to have a successful holiday is environmental quality. In particular, one of the main objectives shared by the biggests hotel chains is the maintenance of bathing water and beach quality, animal protection in the vicinity of hotels, and the phased reduction of environmental impact through small systematic steps such as improvements in eco-efficiency (energy consumption, water consumption, waste avoidance, reductions in land use, etc.) in thousands of holiday hotels. A very interesting (and recent) example of accommodation firms whose managers are eager to institute programs that save water, save energy and reduce solid waste--while saving money--to help the environment is the "Green" Hotels Association that involve from B&Bs to military installations in Usa, Canada, Mexico, the Caribbean, Central and South America, Europe, Asia and all around the world. This association encourages, promotes and supports the "greening" of the lodging industry.

Hotels that have implemented programmes of environmental quality have experienced an increase of the demand that results in direct financial gains and also, there is empirical evidence which proves a growing demand for governments and private industry to take a proactive stance to solve environmental problems (Gustin, M. and Weaver, P. 1996). One of

∗ There are many studies about the investment in environmental quality (for instance: Alvarez, M.J., Burgos, J.J., and Cespedes, J.J., 2001; Burgos, J., Cano, G., and Céspedes, L., 2002; Calveras, A. 2003; Gonzalez, M., and León, C.J., 2001; Gustin, M. and Weaver, P. 1996; Hornemann, L., Beeton, R. and Huie, J., 1997; Hunter, C., 1997).

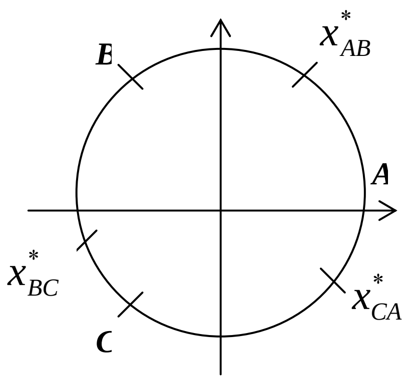
the long term aims of environment friendly hotels chains is the introduction of realistic environmental standards for water, noise and air to make environmental quality quantifiable and to be used as part of the advertaising campaign.

The aim of this paper is to show that the incentive of hotel chains to invest in environmental quality directly depends on the demand for days of rest on the part of tourists and on the level of aggregate income. The framework is based on a theoretical model of horizontal differentiation à la Hotelling introduced in (Calveras, A. 2003). We modify this model by introducing a demand function for tourism commodities and our framework model includes three tourist regions, several hotel establishments and three tour operators. We show that an increase on total income induces hotels in the regions whit highest price to invest in environmental quality. This implies also that if a chain has hotels only in the most expensive region then an increase on total income is an incentive to move to the other regions. The paper is organized as follows. In section 2 we introduce and analyze the model. Conclusions and future developments are summarized in the last section.

THE MODEL

We present a model that includes three tourist regions (A, B C), several hotel establishments and 3 tour operators. Each tourist has to choose the region where to sojourn. Following (Salop, S. 1979), we suppose that each region is located in an infinite line or the unit circle (Figure 1).

Figure 1. The distribution curve of tourist and the regions position



We adopt this unrealistic assumption to ignore the corner difficulties of the original Hotelling model. The tourists are uniformly distributed along the circle and the regions are positioned at equal intervals.

There are n_R hotels with *k* units of capacity in each region, where *k* is taken as exogenous and *R* is an element of {*A, B, C*}. Given that the transportation cost is τ per unit of distance, then a tourist located at point *x* in the circle that goes to region *R* for vacation has a transportation cost of τ times the distance between *x* and *R*. We will denote by $Q_{R_i} \geq 0$ the investment in environmental quality of hotel R_i. and α_R represents the region idiosyncratic parameter, that is, for example, the nature attractions. With this we define the quality of region *R* by:

$$q_R = \alpha_R \frac{\sum^{n_R} Q_{R_i}}{n_R} \tag{1}$$

Note that, in words, this means that the quality of a region is the average of the investment in environmental quality of each hotel, corrected by the idiosyncratic parameter. In addition we suppose the existence of a tour operator in each region (TO_R), that regulates the number of tourists according to the hotels capacity and the carrying capacity of the environment. This agent is an intermediary that acts as conduit for services offered by hotels to the tourists, and fixes the price p_R of the unit of the hotel capacity. Since all hotels are identicals, prices at each region are the same for all hotels. When each tour operator fix the price to maximize its profits, he takes as given the prices of the others two operators and then a Nash equilibrium will be derived from prices. We suppose that the tour operator receives a percentage $1-\delta$ of the net operating profits of tourism accommodations π .

Suppose that the utility function of a representative tourist is given by

$$u(c, d_R) = d_R{}^{\beta} c^{1-\beta} \tag{2}$$

where $0 < \beta < 1$, d_R is the number of days that a tourist occupies a unit of hotel in region *R* $(1 \leq d_R \leq D)$ and *c* is the consumption of others good $(c \geq 0)$.

We also assume that the consumer distributes his income following the linear restriction:

$$y = c + r_R d_R \tag{3}$$

where r_R is the price to rent an hotel room in region *R*, and the price of *c* is normalized at 1.

If we maximize theconsumer utility function (2) subject to the restriction (3), we find the demand function of occupation of hotel rooms in each region:

$$d_R = \beta \frac{y}{r_R} \tag{4}$$

Note that

$$U(x, R) = d_R + vq_R - p_R - \tau |x - R| \tag{5}$$

is a measure of welfare of an average tourist that is located at point *x* in the circle with a demand d_R days of hotel room in region *R* with quality q_R and price p_R (where v is a positive parameter).

Let consider a tourist who is indifferent between going to regions $J \text{ or } I \in \{A, B, C\}, J \neq I$, and is located at point *x* of the circle. Then we must have:

$$U(x^*, J) = U(x^*, I) \qquad \text{for } J, I \in \{A,B,C\} \text{ and } J \neq I \tag{6}$$

Additionally, we suppose that transportation costs are so high such that a tourist that is indifferent between going to *I* and *J* must be located at the smaller arc of the circle determined by *I* and *J* for $J, I \in \{A,B,C\}$ and $J \neq I$. This is a technical assumption.

From equation (6) we can obtain $x_{JI}{}^*$, the position in the circle at which the tourist is indifferent between going to *J* or *I*:

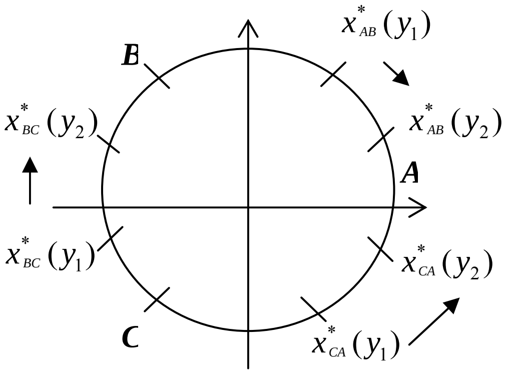
$$x^*_{AB} = (p_A, p_B) = \frac{\beta y\left(\frac{1}{r_A} - \frac{1}{r_B}\right) + v(q_A - q_B) - (p_A - p_B)}{2\tau} + \frac{\pi}{3} \qquad (7)$$

$$x^*_{BC} = (p_B, p_C) = \frac{\beta y\left(\frac{1}{r_B} - \frac{1}{r_C}\right) + v(q_B - q_C) - (p_B - p_C)}{2\tau} + \pi \qquad (8)$$

$$x^*_{CA} = (p_A, p_C) = \frac{\beta y\left(\frac{1}{r_C} - \frac{1}{r_A}\right) + v(q_C - q_A) - (p_C - p_A)}{2\tau} + \frac{5\pi}{3} \qquad (9)$$

These results are coherent with those on (Accinelli,E., Brida, J.G. and Carrera, E., 2006) in the following sense: if $r_A > r_B, > r_C$, then by (7), (8) and (9) x^*_{AB} and x^*_{BC} depends negatively on the income y, x^*_{CA} depends positively. That is, when $r_A > r_B, > r_C$ an increase in the income level produces a clockwise movement of the indifferent points x^*_{AB} and x^*_{BC} and a counterclockwise movement of x^*_{CA}. This implies an increment in the demands of hotel rooms in region C and a decrease in the demand in region A. Note that in region B the demand for hotel rooms can increase or decrease, depending on the parameters. (See Figure 2)

Figure 2. Movements of the indifference point when $r_A > r_B > r_C$ and the total income increases from y_1 to y_2.



Then an increase in the income level produces an increase on the demand of the cheapest hotel rooms and a decrease on the demand of expensive rooms.

The next step is that each tour operator has to maximize their benefits, subject to capacity of the region. We know that the demand faced by the hotels of region *A* is $x_{AB}^{*} - x_{CA}^{*} + 2\pi$ (see Figure 1), for hotels of region *B* is $x_{BC}^{*} - x_{AB}^{*}$, and, finally for region *C* we have that $x_{CA}^{*} - x_{BC}^{*}$. Then the problem that faces the TO_R is:

For $R = A$

$$\max_{p_A} (1-\delta) p_A.(x_{AB}^{*} - x_{CA}^{*} + 2\pi) \quad (10)$$

$$\text{s.t. } n_A k \geq x_{AB}^{*} - x_{CA}^{*} + 2\pi \quad (11)$$

For $R = B$

$$\max_{p_B} (1-\delta) p_B.(x_{BC}^{*} - x_{AB}^{*}) \quad (12)$$

$$\text{s.t. } n_B k \geq x_{BC}^{*} - x_{AB}^{*} \quad (13)$$

For $R = C$

$$\max_{p_C} (1-\delta) p_C.(x_{CA}^{*} - x_{BC}^{*}) \quad (14)$$

$$\text{s.t. } n_C k \geq x_{CA}^{*} - x_{BC}^{*} \quad (15)$$

To solve the respective system, each tour operator take as given the prices of the other regions. Under this assumption we find that the prices of equilibrium are:

$$p_A^*(q_A,q_B,q_C)=\frac{\beta y\left(\frac{2}{r_A}-\frac{1}{r_B}-\frac{1}{r_c}\right)+v(2q_A-q_B-q_C)}{5}+\frac{2\pi\tau}{3} \quad (16)$$

$$p_B^*(q_A,q_B,q_C)=\frac{\beta y\left(\frac{2}{r_B}-\frac{1}{r_A}-\frac{1}{r_c}\right)+v(2q_B-q_A-q_C)}{5}+\frac{2\pi\tau}{3} \quad (17)$$

$$p_C^*(q_A,q_B,q_C)=\frac{\beta y\left(\frac{2}{r_C}-\frac{1}{r_A}-\frac{1}{r_B}\right)+v(2q_C-q_A-q_B)}{5}+\frac{2\pi\tau}{3} \quad (18)$$

Note that if the price of hotels in region A is too high in relation to the others prices (for instance, when $2/r_A - 1/r_B - 1/r_C < 0$) then an increase in the income produces a decrease in the price of the tourist operator in region *A* (the region with expensive rooms) and, with high probability, an increase in the others two prices (supousse that region C is the cheapest). These prices can be substituted in (7) – (9) to obtain:

$$x_{AB}^*(q_A,q_B)=\frac{\beta y\left(\frac{1}{r_A}-\frac{1}{r_B}\right)+v(q_A-q_B)}{5\tau}+\frac{\pi}{3} \quad (19)$$

$$x_{BC}^*(q_B,q_C)=\frac{\beta y\left(\frac{1}{r_B}-\frac{1}{r_C}\right)+v(q_B-q_C)}{5\tau}+\pi \quad (20)$$

$$x_{CA}^*(q_A,q_C)=\frac{\beta y\left(\frac{1}{r_C}-\frac{1}{r_A}\right)+v(q_C-q_A)}{5\tau}+\frac{5\pi}{3} \quad (21)$$

These are the values of the indifferent point as a function of the environmental quality of the regions. Note that an increase in income produce effects on the indifference points as those produced for prices. That is: if income increases, then the price of the most expensive region falls, implying that hotels in region A must increment the investment in environmental quality in order to maintain their demand.

Suppose now that there is a chain that has hotels in the three regions. Let also suppose that investment in environmental quality of the hotel *i* in region *R*, has a cost of $c(Q_{R_i})$, where $c'(Q_{R_i}) > 0$, $c''(Q_{R_i}) > 0$ and $c'(0) = 0$. In the first step we analyze the problem that faces a hotel *i* $(\text{for } i = 1 \ldots n_A)$, established only in the region *A*; i.e.,

$$\max_{Q_{A_i}} \pi_i(Q_{A_i}) = \max_{Q_{A_i}} \delta . p_A^* . \frac{(x_{AB}^* - x_{CA}^* + 2\pi)}{n_A} - c(Q_{A_i}) \qquad (22)$$

The FOC of this problem are:

$$\delta \left[2 \frac{v \alpha_A}{5 n_A} \frac{(x_{AB}^* - x_{CA}^* + 2\pi)}{n_A} + \frac{p_A^*}{n_A} \frac{2 v}{5 \tau} \frac{\alpha_A}{n_A} \right] - c'(Q_{A_i}) = 0 \qquad (\text{for } i = 1 .. n_A) \quad (23)$$

Note that, by the equation (23), an increase in the investment on environmental quality implies an increase in the price received by the hotel and in the total demand of hotel services in region A. Equation (23) can be written as:

$$4\delta \frac{v \alpha_A}{5 n_A^2} (x_{AB}^* - x_{CA}^* + 2\pi) = c'(Q_{A_i}) \qquad (\text{for } i = 1 \ldots n_A) \qquad (24)$$

From (24) we can deduced that an increasse on the demand for hotels in region A, estimulates the investment on envoirment quality in this region.

Let now considered a hotel chain formed by $\hat{n}$ hotels: $\hat{n}_A$ in region *A*, $\hat{n}_B$ in region *B*, and $\hat{n}_C$ in the *C* region. Then the problem faced by the chain is:

$$\max_{\bar{Q}} \delta \left[\hat{n}_A p_A^* \frac{(x_{AB}^* - x_{CA}^* + 2\pi)}{n_A} + \hat{n}_B p_B^* \frac{(x_{BC}^* - x_{AB}^*)}{n_B} + \hat{n}_C p_C^* \frac{(x_{CA}^* - x_{BC}^*)}{n_C} \right] - \sum_{i=1}^{\hat{n}} c(Q_i) \qquad (25)$$

Then, in order to decide how much to invest in hotel *i* in the region A the first order condition with respect to Q_{A_i} is:

$$\frac{\hat{n}_A}{n_A}\left[\frac{\partial p_A^*}{\partial Q_{A_i}}(x_{AB}^*-x_{CA}^*+2\pi)+\frac{\partial(x^*{}_{AB}-x^*{}_{CA}+2\pi)}{\partial Q_{A_i}}p_A^*\right]+\frac{\hat{n}_B}{n_B}\left[\frac{\partial p_B^*}{\partial Q_{A_i}}(x_{BC}^*-x_{AB}^*)-\frac{\partial x_{AB}^*}{\partial Q_{A_i}}p_B^*\right]$$

$$+\frac{\hat{n}_C}{n_C}\left[\frac{\partial p_C^*}{\partial Q_{A_i}}(x_{CA}^*-x_{BC}^*)+\frac{\partial x_{CA}^*}{\partial Q_{A_i}}p_C^*\right]=c'(Q_{A_i}) \quad (26)$$

This equation (21) indicates how much to invest in hotel *i* located in region *A*. Being that the second term of (26) is multiplied by $\hat{n}_B/n_B$ (the participation of the chain in the total of hotels in region *B*) and that the factor multiplying $\hat{n}_B/n_B$ is negative, then if $\hat{n}_B$ increases, the incentive to invest in environmental quality of hotels located in region *A* decreases. A similar remark is valid for the third term.

Given the total income *y*, let $x^*(y)=\left(x_{AB}^*(y),x_{BC}^*(y),x_{CA}^*(y)\right)$ given by (7) – (9) and $\left(p_A^*(y),p_B^*(y),p_C^*(y)\right)$ given by (16) – (18). If we assume that there is a marginal change in the income $y_1<y_2$ and that $r_A > r_B > r_C$, then the indifference point $x^*(y_1)$ changes to $x^*(y_2)$ following the movements decribed above in this paper and $p_A^*(y_1)>p_A^*(y_2)$ and $p_C^*(y_1)<p_C^*(y_2)$. This means that x_{AB}^* and p_A^* are decreasing functions of the total income *y*. Then, from equation (26) it follows that an increase in total income *y* produces a decrease in investment on environmental quality in the region where prices of rooms is higher. That is, if total income increases then the incentive to invest in environmental quality increases in the region whit lowest price and it diminishes in the region with highest price. Nothing can be inferred for the third region.

CONCLUSION AND FURTHER RESEARCH

In this paper we analyze the impact of tourist demand in hotel rooms on the investment of hotel chains on environmental quality. In particular we show that when income of the agents increases, then the hotel chain must increase the investment on the environmental quality of the region where there is an increment of the tourist activity. This paper can be generalized in different ways. For istance, we can suppose that instead of three tourist regions we have $n > 3$. We can improve our model by introducing different types of hotel rooms in the different regions and introducing utility functions for the tourists where preference for rooms depends on non homogeneous goods.

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