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A NOTE ON THE MECHANISMS TO OBTAIN SUSTAINABLE ECOTOURISM THROUGH PRICE MANAGEMENT

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This note studies a market signal mechanism for assessing the short and long term tradeoff offered by the existence of natural resources in a tourism destination. We develop a theoretical model in which the destination price index is the tool for obtaining the sustainability of tourist areas. We assume that the stock of natural resources accumulates due to the regenerative natural capacity, but, at the same time, it is negatively affected by the number of tourists. When the demand price elasticity is higher than one, we show that there is a tradeoff between the use of the natural resources and the development of the tourism sector. In this scenario, we analyze how the optimal price changes as the parameters of the model vary.

Keywords: *tourism, environmental sustainability, price elasticity of demand*

JEL Classification: *L83, M1, O1*

INTRODUCTION

It is well-known that international tourism has positive effects on long-run economic growth through different channels. First, tourism is a significant foreign exchange earner, which allows to import capital goods or basic inputs used in the production process. Second, tourism plays an important role in spurring investments in new infrastructure and competition between local firms and firms in other tourist countries. Third, tourism stimulates other economic industries by direct, indirect and induced effects. Fourth, tourism contributes to the generation of employment and to increase income. Fifth, tourism allows the exploitation of economies of scale in national firms (see Andriotis, 2002; Brida and Risso, 2010; Croes, 2006; Fagance, 1999; and Lin and Liu, 2000). Finally, tourism is an important factor of diffusion of technical knowledge, stimulation of research and development, and accumulation of human capital. The theory that considers tourism as a factor that causes long-run economic growth is known in the literature as the Tourism Led Growth Hypothesis. (see Balaguer and Cantavella-Jordá, 2002; Brida et al., 2008; Brida et al., 2009; Brida et al., 2010; Brida et al., 2010b; Shan and Wilson, 2001) Tourism is the leading source of foreign exchange in at least one of three developing countries that have made it a priority sector, and this holds especially for small islands (see Schubert et al., 2011). From the one hand, it is important to note that a portion of the foreign exchange generated by tourism is expatriated by Transnational Corporations, through transfer pricing. This is particularly true for small economies where most of tourism industry is not owned by residents. On the other hand, the role of environmental quality in the process of tourism development and economic growth must be considered, in particular for those countries that depend heavily on international tourism revenue and whose tourist sector is based on natural and environmental resources. As pointed by (Cerina, 2007), there is a twofold relationship between natural resources and tourism. The presence of natural attractions in a particular destination impacts positively the arrival of tourists, and at the same time, natural resources are negatively affected by intensive tourism.

As stated in Butler's classic article on the Tourist Area Cycle of Evolution (Butler, 1980) there is a tradeoff between the short and long term incentives to obtain a sustainable tourism sector for the economy. More precisely, Butler affirms that "While the maximum number of people visiting an area at any one time under such arrangements may be less than most present policies of maximum short-term development, more visitors could be catered for in the long term".[1] Although the author does not mention the list of instruments to manage the tradeoff, from the literature can be inferred that most of them are designed to keep tourists' arrivals within predetermined capacity limits, or to increase the capacity limits.

The economic performance of small open economies that depend heavily on international tourism revenues and whose tourism sector is mainly based on natural resources poses interesting interrogations regarding the role of environmental assets on the sustainability and effectiveness of their development process. For example, is economic growth of these economies sustainable in the long run? Can the market itself guarantee the development of the tourism sector in such a way that the use of environmental resources is efficient or the intervention of the state is needed in order to regulate the market? In this paper we propose a mechanism based on the employment of a market signal suitable for assessing the short and long term tradeoff offered by the existence of natural resources in a tourism destination. To this end, we develop an intertemporal model for a small open economy in which the destination price index is the tool to obtaining the sustainability of tourist areas. Our dynamic model can be placed within the theoretical literature about the relation between tourism and economic growth, which was originated by the classic articles of (Hazari and Ng, 1993) and (Hazari and Sgro, 1995).[2]

Industrial Organization models usually explain the price as a consequence of the interaction between supply and demand, where consumers and firms optimize their respective utility and profit. In this paper, the price is a tool which influences the sustainability of natural resources consumption. The economic analysis concerning the sustainability of the renewable resource in a tourist area has been framed in the literature of sustainable growth with renewable resources and pollution. These models analyze the combination of three main assumptions. First, it is assumed that the number of tourists negatively affects the natural resources though wastes, ecosystem alteration, impacts on wildlife and pollution. Second, it is supposed that the quality of the environment accumulates due to the regenerative capacity of nature. Finally, it is presupposed that the utility of tourists is negatively influenced by prices in the destination. The assumption about how the tourism activity affects natural resources is elaborated through different mechanisms. (Hernández and Leon, 2004) assume a predator-prey scheme between the physical and the natural capital in tourism development. The physical capital (predator) needs the natural capital (prey) to grow through the joint generated rent, but natural capital is degraded by the existence of the former one. On the other hand, (Lozano Ibáñez et al., 2005) assume that natural resources is affected by the number of units of accommodation, i.e. beds, at the destination, and, (León et al., 2007) by the number of tourists. Furthermore, (Cerina, 2007) assumes that tourists' entries generate pollution reducing the stock of environmental quality.

The assumption on the law of accumulation of the natural resources has been dominated by a bounded and concave reproduction function as in (Wirl, 2003; Ayong Le Kama, 2001; Hernández and Leon, 2004; and Lozano Ibáñez et al., 2005). This class of functions is based on the assumption that an exogenously given rate of regeneration is associated with an ideal quality of the natural resource. The perturbations of the system set in motion a mechanism of natural regeneration proceeding towards the ideal quality. However, (Cerina, 2007) introduces the possibility to undertake measures to reduce the negative impact of the tourism activity. As the abatement is costly, Cerina models the tradeoff between extracting resources from the economy's output and the deterioration of the natural resource. Finally, the behavioral assumption of the models is dominated by the optimization of an intertemporal utility function. The aggregate utility comes from consumption and the level of natural resources as in (Cerina, 2007; León et al., 2007; and Lozano Ibáñez et al., 2005). The intertemporal utility was revised by the Green Gold Rule in (Beltratti et al., 1993), where the households obtain the highest indefinitely maintainable level of instantaneous utility (see also Ayong Le Kama, 2001; and Wirl, 2003).

The theoretical model studied in this note leads to two main results: 1) when the price elasticity of demand is lower than one (inelastic), or equal to infinity (perfectly elastic) the price is not a good instrument to control the deterioration of the natural resources. The optimal solution is to increase the price to infinity, meaning that there would be no tourists and the quality of natural resources would be the highest; 2) on the other hand, when the demand price elasticity is higher than one, there is a tradeoff between the use of natural resources and the development of the tourism destination. This final result encompasses four further conclusions: 1) when the demand price elasticity increases, the proportion of the natural resources employed increases; 2) when the elasticity of demand to quality of the natural resources increases, the proportion of the natural resources employed decreases; 3) when the speed of recovering of the natural resources increases, the proportion of the natural resources employed decreases; 4) when the discount rate increases, the proportion of the natural resources employed increases.

Our conclusions have relevant policy implications. The price of tourism services constitutes a relevant and effective tool in order to control the use of natural resources, whenever the demand price elasticity is higher than one. In particular, the policymaker is able to influence the price of the tourism destination by using of the fiscal leverage so as to decrease the proportion of natural resources employed. The application of these charges produces a change in the general level of price at the tourist destination, which at time, reinforces the use of a price index in the model.

The article is organized in three sections. Section 2 presents the model, in the third section we solve the model and the main results are derived. Final conclusions are included in the last section.

THE MODEL

We study a model of a tourist destination, endowed with an environmental resource which is the main attraction for visitors. According to the existing literature a visitor obtains utility from several sources. For example, from the quality and quantity of: services supplied by privates, public goods provided by local authorities and environmental or cultural and social resources. Since this paper focuses on the interaction between the number of tourists and the stock or quality of environmental, the attention is restricted to the utility obtained from an environmental renewable resource.

We assume that, at any time t, tourists satisfaction are positively influenced by the current stock or quality of environmental resources which is defined by a general index of "environmental quality" denoted by E.[3] Prices of the destination are simplified with an index price P.

Total tourist demand is defined by:

$$D = D(E, P) \tag{1}$$

As usual, we assume that $D_E > 0$ and $D_P < 0$.

The economy supplies tourism services in an international tourism market where a large number of tourism economies participate. It is important to highlight that although international competition fixes the price for a given quality of services, a country could charge a higher price provided that its services are considered of a higher quality (i.e. characterized by a higher stock of environmental, cultural and social resources) than other countries, without losing all the demand. That is, the international market has a monopolistic competitive structure represented by a continuum of tourism markets differentiated by their quality and the (equilibrium) price paid for tourism services. It is assumed that other markets prices remain fixed.

Each tourist buys one unit of tourism services and there is a fix marginal cost for supplying a unit of tourism services. The tourist area is populated with a constant population of identical infinitely-lived residents whose number is normalized to one. Residents own firms that provide tourism services, so they obtain the profits:

$$\Pi = PD(E,P) - cD(E,P) \qquad (2)$$

Where c is the marginal cost and $D(E,P)$ is the tourist demand, or the total number of visitors arriving at time t, as a function as the environmental quality state E and the price P.

For the sake of simplicity, it is assumed that the country provides tourism services with labor and natural resources. Thus, residents consume all profits, and then we have: $C = \Pi$ at any time t.

Residents have a lifetime utility given by:

$$\mathrm{U}(P) = \int_{t=0}^{\infty} e^{-\rho t} u(\Pi_t) dt \qquad (3)$$

where $\rho > 0$ is the subjective discount rate and u, the instantaneous utility of residents, depends on the profits that they obtain from running their tourist firms.

The environmental resource is the main attraction for tourists and its quality is described by the state variable E. The quality of the environment accumulates due to the regenerative capacity of nature that depends on the level of environmental quality. Tourism activity has damaging effects on the environment (Davies and Cahill, 2000), and the intensity of the negative impact is closely related to the number of visitors at the destination.

Thus, it is assumed that the environmental quality evolves over time according to:

$$\dot{E} = \phi(E_s - E) - \beta D(E,P) \qquad (4)$$

The first term in the right side of the differential equation shows that the quality of natural resources moves to a highest natural state E_s with the speed ϕ, with $0 < \phi \leq 1$. This term represents the natural rate of recovery of the system due to regeneration. The second term represents the negative visitor impacts on the environmental quality. Because tourists increase wastes, lead to ecosystem alteration, impact on wildlife, it assumed that every tourist generates the level of pollution β with $\beta > 0$. It is suggested in (Lozano Ibáñez et al., 2005) that different type of visitors produce different impacts. It is assumed here that β captures the average impact of every tourist. Notice that without tourist intervention, i.e. if $\beta = 0$, the quality of natural resources will be in its highest natural quality state E_s.

THE SOCIAL OPTIMUM

A benevolent social planner chooses the price in each t, $P(t) \geq 0$, that maximizes the objective (3) subject to the equation of the renewable tourist resources (4).

Without loss of generality it is assumed that the marginal cost is negligible $c = 0$. Moreover, we suppose that the demand function is given by $D(P, E) = E^{\theta} P^{-\alpha}$, where $\theta > 0$ and $\alpha > 0$ represent tourist demand elasticity respect to the quality and the price, respectively.

Assuming a logarithmic instantaneous utility function, the Hamiltonian of this system is given by:

$$H = \theta LogE + (1 - \alpha)LogP + \mu\big(\phi(E_s - E) - \beta E^{\theta} P^{-\alpha}\big) \qquad (5)$$

In the Appendix we present the solution of the dynamic optimization problem. It is important to point out that the optimal autonomous system has two different behaviors according to the value of the demand price elasticity. When the price elasticity is inelastic, or perfectly elastic the price is not a good instrument to control the deterioration of the natural resources. The optimal solution is to increase the price to infinity. In this case there would be no tourists and the quality of the natural resources would be the highest (E_s).

When the demand price elasticity is higher than one (i.e. $\alpha > 1$), there is a tradeoff between the use of natural resources and the development of the tourism destination.

The price in the stationary state

As it is shown in the Appendix, the stationary price is given by:

$$P = \left[\frac{E^{-\theta}(\alpha - 1)}{\mu\alpha\beta}\right]^{-1/\alpha} \qquad (6)$$

Substituting the optimal expenditure E^* and μ^* (see equation (17) in the Appendix) we obtain that the price is given by:

$$P = \left[\frac{(-1+\alpha)(\rho+\phi)\left[\frac{E_S\theta\phi}{(-1+\alpha)\rho+(-1+\alpha+\theta)\phi}\right]^{1-\theta}}{\beta\theta}\right]^{-1/\alpha}$$

That can be synthesized as:

$$P = \left[\frac{\beta\theta}{(\alpha-1)(\rho+\phi)(E^{\star})^{1-\theta}}\right]^{1/\alpha} \tag{7}$$

Which, given the fact that $D(P,E) = E^{\theta}P^{-\alpha}$, yields the following demand in equilibrium:

$$D = E_s\frac{(\alpha-1)(\rho+\phi)}{(\alpha-1)(\rho+\phi)+\theta\phi} \tag{8}$$

Note that the demand in the steady state depends on the demand elasticity for natural resources θ, the price elasticity of demand α, the subjective intertemporal substitution ρ , the speed of recovering of the natural resources ϕ and finally the quality of natural resources.

The quality of natural resources

In stationary state, there is a fraction of the quality of the natural resources that is used by tourists. This proportion Ω of natural resources employed is given by:

$$\Omega = 1 - \frac{E^{\star}}{E_s} = \frac{(\alpha-1)(\rho+\phi)}{(\alpha-1)(\rho+\phi)+\theta\phi} \tag{9}$$

Where $E^{\star}$ is the quality of the natural resources in the stationary state.

It is interesting to study how the price and the proportion of natural resources change, as the parameters of the model vary. Consider the case when the price elasticity if higher than one. In the first place, when the price elasticity of demand increases, in order to compensate this change the social planner has to decreases the price (see equation 7). Then, tourists' demand increases, and so the use of natural resources. In the second place, an increase of the demand elasticity for natural resources, leads to an increase of tourists' demand which is compensated with a higher price. Thus, a decrease in the use of natural resources is produced. In the third place, if the speed of recovering of natural resources increases, the price also increases (see equation 7) and then, the use of the natural stock decreases. Finally, when local agents valuate more the present period respects to future periods (that is, when ρ grows), then since the tourists' demand price elasticity is higher than 1, the social planner will decrease the price in order to attract more tourists. This situation produces a higher level of employed natural resources. These results allow us to cast some light on the different ways that the price and tourists' demand are expected to change with the parameters of the model. We summarize this analysis in the following Proposition.

Proposition 1: When the price elasticity is higher than one (i.e. $\alpha > 1$), the proportion of natural resources used in steady state changes according to the demand elasticity respect to natural resources θ, the price elasticity of demand α, the subjective intertemporal substitution ρ and the speed of recovering of the natural resources ϕ, in the following way:

a) When the price elasticity of demand increases, the proportion of the natural resources employed increases.

b) When the elasticity of demand to the quality of natural resources increases, the proportion of the natural resources employed decreases.

c) When the speed of recovering of natural resources increases, the proportion of the natural resources employed decreases.

d) When the discount rate increases, the proportion of the natural resources employed increases.

Proof: The proof of proposition comes from the signs of the derivatives in each case.

Item a) When α increases the sign of the change in Ω is given by:

$$\frac{\partial\Omega}{\partial\alpha} = \frac{\theta\phi(\rho+\phi)}{((\alpha-1)(\rho+\phi)+\theta\phi)^2} > 0 \qquad (10)$$

The higher is the elasticity of demand to the price (α), the larger will be the gap between the maximum optimal environment and the actual one.

Item b) When θ increases the sign of the change in Ω is given by:

$$\frac{\partial\Omega}{\partial\theta} = -\frac{(\alpha-1)\phi(\rho+\phi)}{((\alpha-1)(\rho+\phi)+\theta\phi)^2} < 0 \tag{11}$$

When the utility that people enjoy from an increase in the environmental quality is elastically related to demand, the index of proportional environmental quality is close to E_s. Notice that the price in stationary state will be higher, as the tourists demand more quality and are willing to pay for such an increase in quality. Examples of this situation are exclusive places where people enjoy the quality and they are willing to pay for it.

Item c) When ϕ increases the sign of the change in Ω is given by:

$$\frac{\partial\Omega}{\partial\phi} = -\frac{(\alpha-1)\phi\rho}{((\alpha-1)(\rho+\phi)+\theta\phi)^2} < 0 \tag{12}$$

Item d) Finally, when ρ increases the sign of the change in Ω is given by:

$$\frac{\partial\Omega}{\partial\rho} = \frac{(\alpha-1)\phi\theta}{((\alpha-1)(\rho+\phi)+\theta\phi)^2} < 0 \tag{13}$$

The previous proposition shows the expected changes in the proportion of natural resources used by the tourist sector, when the main parameters of our model vary. An interesting application of these results would be to test their predictions with real data about different tourism markets.

FINAL REMARKS

In this paper we developed an intertemporal model in which the price index of a tourist destination is used for assessing the short and long term tradeoff offered by natural resources. In particular, we present a mechanism based on the employment of a market signal suitable for reaching environmental sustainability in the destination.

Within this framework we show that there is a relationship between the demand price elasticity and the natural resources deployment. More precisely, if it is higher than one, then we have a tradeoff between the use of environmental resources and the development of the tourism industry in the destination. In particular, an increase of either the price elasticity of demand or the discount rate, leads to a growth in the proportion of employed natural resources. Moreover, when there is an increase of the demand elasticity respect to the quality of environmental resources or the speed of recovering of natural resources increases, the proportion of natural resources employed decreases.

It would be interesting to introduce taxes on the price index of the destination. With this tool, the central planner will be able to influence the demand for natural resources in order to decrease the share of natural resources deployed so as to increase long run sustainability.

APPENDIX

The appendix section shows the two analytical developments of the paper.

The benevolent social planner solves the following problem:

$$\max_{\mathrm{P}} \mathrm{U}(P) = \int_{t=0}^{t=\infty} e^{\rho t} log(\Pi) dt$$

Subject to:

$$\dot{E} = \phi(E_s - E) - \beta D(E, P)$$

Where $\Pi = PD(E,P)$ and $D(E,P) = E^{\theta} P^{-\alpha}$.

Thus, the Hamiltonian of the problem is:

$$H = \theta LogE + (1-\alpha)LogP + \mu\big(\phi(E_s - E) - \beta E^{\theta} P^{\alpha}\big)$$

And the first order conditions are:

$$\frac{\partial \mathrm{H}}{\partial \mathrm{P}} = \frac{1-\alpha}{P} + E^{\theta} P^{-1-\alpha} \alpha\beta\mu = 0 \qquad (14)$$

$$\frac{\partial \mu}{\partial t} = \rho\mu - \frac{\partial H}{\partial E} = -\frac{\theta}{E} + \mu\rho - \mu(-E^{-1+\theta}P^{-\alpha}\beta\theta - \phi) \quad (15)$$

$$\frac{\partial H}{\partial \mu} = \frac{\partial E}{\partial t} = (E_s - E)\phi - \beta E^{\theta}P^{-\alpha} \quad (16)$$

Using (14), P can be expressed as:

$$P = \left[\frac{E^{-\theta}(\alpha - 1)}{\alpha\beta\mu}\right]^{-1/\alpha}$$

After some computations, the following dynamical system is obtained:

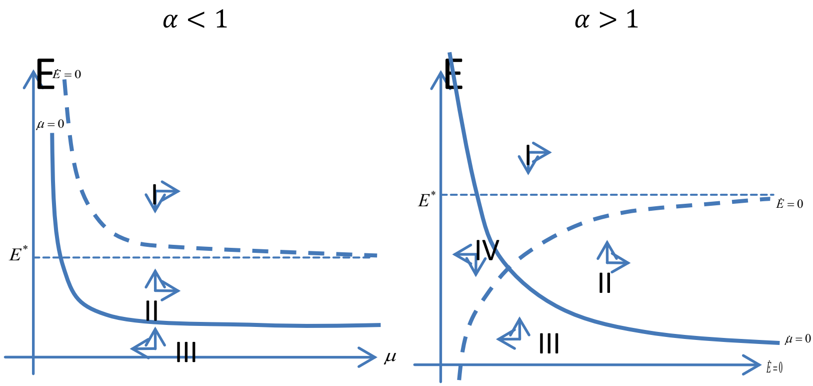
$$\dot{\mu} = \mu(\rho + \phi) - \frac{\theta}{E\alpha} \quad (17)$$

$$\dot{E} = \phi(E_s - E) + \frac{1 - \alpha}{\mu\alpha} \quad (18)$$

The system has three different regimes according to the price elasticity of demand α. The qualitative behavior of the system is presented for the cases of inelastic and elastic demand, i.e. $\alpha < 1$ and $\alpha > 1$, in Figure 1.

When the demand is perfectly elastic, i.e. $\alpha = 1$, the qualitative behavior is similar to the case of inelastic demand $\alpha < 1$, although the coupling between the two state variable bears a cleavage (See Section 3 for the case α=*1*).

Figure 1 Qualitative Analysis of the Optimal Solution



The steady state of this system is:

$$\mu^{\star} = \frac{(\alpha - 1)(\rho + \phi) + \theta\phi}{E_s \alpha\phi(\rho + \phi)}$$
$$E^{\star} = \frac{E_s \theta\phi}{(\alpha - 1)(\rho + \phi) + \theta\phi} \qquad (19)$$

The local stability of the system it is analyzed from the Jacobian:

$$J = \begin{bmatrix} \frac{\partial \dot{\mu}}{\partial \mu} & \frac{\partial \dot{\mu}}{\partial E} \\ \frac{\partial \dot{E}}{\partial \mu} & \frac{\partial \dot{E}}{\partial E} \end{bmatrix} = \qquad (20)$$

$$\begin{bmatrix} \rho + \phi & \frac{((-1+\alpha)\rho + (-1+\alpha+\theta)\phi)^2}{E_S{}^2 \alpha\theta\phi^2} \\ \frac{E_S{}^2 (1-\alpha)\alpha\phi^2(\rho+\phi)^2}{((-1+\alpha)\rho + (-1+\alpha+\theta)\phi)^2} & -\phi \end{bmatrix}$$

Where the determinant is:

$$|J| = \frac{(\rho + \phi)^2(1 - \alpha) + (\rho + \phi)\theta\phi}{\theta} \qquad (21)$$

And the trace of the Jacobian is ρ.

ENDNOTES

1. Butler (1980), page 12.
2. See also (Brida and Pereyra, 2009) and (Accinelli et al. 2007).
3. All variables in our model are defined at each time *t*. However, in order to make the notation lighter, we will not use the subscript *t*.

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