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a Cyclical Perspective for Small  
Island Tourist Economies**

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# **Environmental Quality and Long Run Tourism Development a Cyclical Perspective for Small Island Tourist Economies**

## **Summary**

As tourism is becoming one of the most important sectors of the world economy, the number of small islands trying to develop a competitive tourist activity is increasing and this strategy appears as growth enhancing. In most cases, it is built on the environmental quality of the destination but also on lodging infrastructures and related services that tourists deserve in order to enjoy a good experience. This paper explores the inter-temporal trade-off between tourist investments and environmental quality preservation needed to ensure population revenues in the long run. It highlights possible cyclical evolution of environmental quality, tourist infrastructures, investments and tourist frequentation.

**Keywords:** Tourism, Environment, Lifecycle, Islands

**JEL Classification:** O1, L83, Q26

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## **1. Introduction**

As tourism is becoming one of the most important sector of the world economy, the number of small islands trying to develop a competitive tourist activity is increasing (Logossah, 2004; Shareef, 2003). Observers have to recognize that an important part of these Small Island Tourist Economies<sup>2</sup> are successful (Lanza and al, 2003; Marques, 2003). Lanza and Pigliaru (2000) shown that seven over the fifteen fastest growing countries between 1985 and 1995 were tourist countries<sup>3</sup> and that most of them were SITE as St Kitts and Nevis, Antigua and Barbuda or Cyprus. Because of their natural endowments, SITE are said to have some kind of advantage in the production of tourist goods and this implies that tourism is often seen by policy makers as the obvious way toward economic development (Crusol et alii, 1989).

Nonetheless tourism must not be conceived as a panacea as a study realized by the World Bank and the Commonwealth secretariat pointed out in 2000. In fact, even though tourism provides economic welfare gains (Copeland, 1991, Nowak, Sahli, 1999, Sinclair 1998) and constitutes a good engine of growth (Hazari and Sgro, 1995, Lanza and alii, 2003), it may also generate static and dynamic perverse effects. Recent theoretical literature has largely explored negative economic consequences of tourism specialisation for small open economies: dependance to foreign capital, inflation, constraint of volatile demand (Sinclair, 1998), market labor disturbances (Nowak, Sahli, Sgro, 2003), Dutch disease effect (Nowak, Sahli, 1999), land competition and land speculation, low-education trap (Augeraud-Veron,

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<sup>2</sup> SITE from now on.

<sup>3</sup> Specialization is defined here as more than 30% of GDP coming from tourism.

Augier, 2003). All of the authors emphasize the risk for small open economies specialised in tourism to become rentier economies (as petroleum ones) with all associated drawbacks. Briefly speaking, tourism specialisation seems to be a short fruitful strategy but a long term competences destroying one.

Surprisingly the reviewed literature does not focus on what is at stake when speaking with sustainability of tourism specialisation : the exploitation of natural capital. Indeed, all tourism yields are based on the direct or indirect exploitation of SITE's environmental assets. And it is well known that insular ecosystems are greatly sensitive to economic activity pressure<sup>4</sup>. In such a context, sustainability of tourism means in a very trivial acception to ensure the preservation of environment while developing tourism activities knowing that i) this tourist development is only possible if the local economy has got all the infrastructures that tourists deserve in order to enjoy a good experience ii) this experience is simultaneously built on the environmental quality of the destination which could be lessen by infrastructures investments, associated services and tourist frequentation they induce.

The aim of this paper is to explore the inter-temporal trade-off between tourism investments and environmental quality preservation needed to ensure population revenues in the long run. In this perspective, we propose a simple dynamic model of tourism development taking into account the quality of the destination as perceived by tourists.

Recent modeling has been produced on this subject using a prey-predator framework (Casagrandi, Rinaldi, 1999, 2002; Kort and alii, 2002). Both papers develop an optimal control modeling highlighting two kinds of sustainable trajectories when maximising tourism

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<sup>4</sup> Islands usually have typical and fragile ecosystems (lagoons, mountains, rivers, etc.) due to specific and unique climatic, geographical and geological characteristics.

profits. A first one is a steady-state where investments in infrastructures just equal the depreciation of their stock. The number of tourists remains constant over time and the increase in pollution is absorbed by the environment. A second sustainable path is given by a cyclical evolution in investments, in the number of tourists, in the pollution stock and in infrastructures inducing different phases in the tourism development and confirming Butler's (1980) lifecycle hypothesis. Tourism development may be sustainable because of alternative phases of high and low frequentation permitting ecosystems to regenerate. One possible conjecture from our SITE's perspective is that an appropriate investments strategy along the lifecycle would prevent the island destination from a declining phase if environment regenerates. We want to alleviate the conditions under which this conjecture is established substituting an environmental quality variable to a pollution stock variable in the basic model. Our contribution is twofold. First our model partly confirms the Butler's lifecycle hypothesis and the Kort and al. (2002) conclusion according to which the competitive tourism industry must limit over time the number of visitors to preserve future profits. We highlight the role of investment decisions on the decline of the number of tourists necessary for the island to join a sustainable tourism development path. We show that when the perceived environmental quality is decreasing tourism lobby may be incited to disinvest in order to preserve environment. Secondly, we evaluate how a change in the price of a journey limiting the number of tourists may be, from a small island point of view, a sustainable way to develop tourism while preserving environment.

The paper is organized as follows. The second section reviews the environmental drawbacks a small island may suffer from tourism specialisation and recalls what was the Butler lifecycle perspective. The third section presents a model of tourism investments when introducing the quality of environment "perceived" by tourists as a state variable of the

dynamic system. In the fourth section, our primary results based on simulations are exposed. The last section concludes and opens up further research on differentiation strategies small islands may implement in the perspective of a sustainable development of tourism.

## **2. Environnemental drawbacks and sustainability of tourism**

The choice of a small economy to develop a competitive tourist activity means that it is looking for the valorisation of its natural (and cultural) endowment. We will consider that tourist specialisation is driven by the high environmental quality of the destination as it constitutes an important attraction factor on the world market of tourism. So, tourists will come and visit the island in order to enjoy its extraordinary landscapes or the great quality of its coastal waters. We have to agree with Punzo and Bimonte (2003) when they define the tourist good as an experience good. The tourist comes to experience a unique trip and may come back if its expectations have been fulfilled.

Yet, tourist development may be at the root of the environmental degradation. In fact, in order to welcome tourists, the island needs to build lodging infrastructures and the multiplication of such infrastructures generates visual pollution leading to a degradation of the experience. Furthermore, when infrastructures are abandoned they can be seen as an irreversible damage for the destination. Then the tourist flow in the destination is synonymous of an increase in the production of wastes and when it goes over a given threshold the environment is unable to assimilate it.<sup>5</sup> Developing the lodging capacities and the tourist flow in a few sites will generate an increased environmental pressure. It may lead to irreversible damages such as the destructions of natural habitats and finally the disparition of species from the ecosystem. So, tourist development has nosive effects more or less irreversible.

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<sup>5</sup> Think at the multiplication of plastic bags floating in the water of the Mediterranean sea.

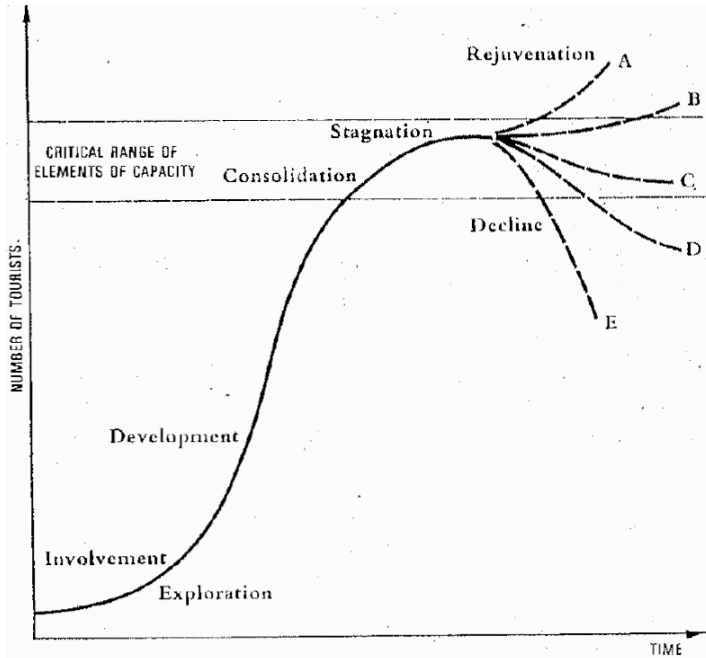
All the stakeholders, from the private sector or representatives of the local community, are aware of these perverse effects. For the host community, a first possible behaviour is to ignore these effects because the population is only interested with short run profits. Nonetheless, a second behaviour is much more plausible : all the stakeholders are looking for a sustainable trade-off between tourist exploitation and environmental conservation that is how to conciliate economic profitability and attractiveness of the island for the tourists in the long run.

Following to the World Tourism Organisation (1995), tourist development will be sustainable if it enhances the way of living of the population without damaging the environmental and cultural capital of the destination. From our island perspective, this means that it is possible in the long run to satisfy an increasing demand, major source of income, without damaging the natural attractions of the island on the tourist market: coastal areas, unique landscapes, animal species, etc. But there is no clear criteria in order to measure the sustainability of a given development strategy. As said by Hawks and Williams (1993), sustainability is a challenge for the destination and it has to increase the lodging capacity and the quality of services without perverse effects on the environment. Then all the problem is to find an equilibrium point between resource exploitation and resource preservation because it is the only way to maintain attractiveness over time. This equilibrium has to be find in the evolution of tourists flows.

By observing the evolution of the number of tourists in a few destinations Butler (1980) identifies what he calls “a lifecycle of destinations” due to a cyclical evolution of the frequentation. A first plausible cause of the cyclical frequentation is the “crowding effect”. As



we already said, tourists are looking for the best possible experience but it will be worsen by the arrival of an increasing tourist flow. So from that point, we will have a fall in the number of tourists because the tourist flow is “destroying” the destination.



**Fig.1: From Butler (1980)**

A second cause of the destination tragedy we think about is the declining environmental quality of the island as we will show in the following section.

### **3. Optimal investment in tourism with environmental quality**

Recent theoretical works explain the different phases in the lifecycle by the interaction between investment in tourist infrastructures and pollution (Casagrandi, Rinaldi, 1999, 2002 ; Greiner and al. 2001 ; Kort and al. 2002). In this section, our aim is to build a simpler optimal investment model than the one built by Kort and al. (2002) using simple functional forms. Moreover it seems to us more suitable to take into account the quality of the environment as it is perceived by tourists visiting the island rather than the pollution stock induced by the tourist

industry. On that point we follow recent literature on sustainable tourism (Lanza and Pigliaru, 1995; Léon, Hernandez, Gonzàles , 2003).

We consider, as in Kort and al. (2002), the point of view of a tourist lobby the problem of whom is to maximise the actualised sum of profits that the island will receive over time in selling tourist journeys.

$$\Pi = \int_0^{\infty} e^{-\rho t} (\pi_t) dt = \int_0^{\infty} (pT_t(S_t, Q_t, p_t) - c(I_t) - d(S_t)) dt^6 \quad (1)$$

with:  $T$  the number of tourists  $Q$ : the quality of the environment  $c(I)$ : investment cost at time  $t$  and  $d(S)$ : maintenance costs at time  $t$ .

We suppose that the price of a journey is exogenously given and constant over time: this is consistent with the standard hypotheses of smallness of the destination and of perfect competition between destinations (the SITE is a price-taker on the world market).

The profit at time  $t$  is increasing with the number of tourists  $T_t$ . Profit is decreasing with the cost of investment and with maintenance cost of the infrastructures.

The number of tourists is monotonically increasing with the quality of the environment. Reciprocally, if the environment deteriorates too much, the tourists will not be incited to come because of the bad environmental quality.

Further more, the number of infrastructures is increasing with the amount of investment but lower because of their depreciation. And, environmental quality is strictly decreasing with the number of tourists.

The number of tourists at time  $t$  is given by:

$$T(S, Q, p) = (\alpha S + \beta Q) p^{-\varepsilon} \text{ where } \alpha, \beta > 0 \text{ and } \varepsilon \geq 0 \quad (2)$$

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<sup>6</sup> From now on, we will skip the temporal index  $t$ .

Investment cost is defined as:  $c(I)=0.5c_1I^2$  with  $c_1>0$  (3)

Maintenance costs are given by:  $d(S) = c_2S$  with  $c_2>0$  (4)

The flow of infrastructures at t is given by:  $\dot{S}=I-\delta S$  with  $\delta>0$  (5)

The variation of environmental quality is given by:

$$\dot{Q} = rQ - \sigma S - \tau T = rQ - \sigma S - \tau[(\alpha S + \beta Q)p^{-\varepsilon}]^7 \quad (6)$$

This formulation needs to be explained.  $r$  is a positive parameter reflecting the dynamics of the ecosystem. To be clear, in the absence of human activity (with  $T=0$  and  $S=0$ ), environmental quality is monotonically increasing at the rate  $r$ . As an example, we can think to the evolution of an endemic plant variety. In the absence of tourists, the number of plants will grow at a given rate  $r$ , increasing biodiversity, but the presence of tourists is going to limit this growth<sup>8</sup> and finally in the case where  $rQ < \sigma S + \tau[(\alpha S + \beta Q)p^{-\varepsilon}]$ , the number of plants, and so for us the quality of the environment ( $Q$ ), is going to decrease.

Finally, the tourist lobby has to solve the following program:

$$\text{Max} \int_0^{\infty} e^{-\rho t} (p^{1-\varepsilon}(\alpha S + \beta Q) - 0.5c_1I^2 - c_2S) dt \quad (1.a)$$

s.c.

$$\dot{S}=I-\delta S \quad (5.a)$$

$$\dot{Q} = rQ - \sigma S - \tau[(\alpha S + \beta Q)p^{-\varepsilon}] \quad (6.a)$$

$$S(0)=S_0>0, Q(0)=Q_0>0$$

The Hamiltonian of the program is written as follows:

$$H = p^{1-\varepsilon}(\alpha S + \beta Q) - 0.5c_1I^2 - c_2S + \lambda_S(I - \delta S) + \lambda_Q(rQ - \sigma S - \tau[(\alpha S + \beta Q)p^{-\varepsilon}]) \quad (7)$$

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<sup>7</sup>  $\sigma S$  denotes the negative effect of an infrastructure on the environment because it exists and  $\tau\alpha S$  the indirect negative environmental effect of an infrastructure because it attracts more tourists.

<sup>8</sup> Stamping, gathering, ripping off usually practiced by tourists.

where  $\lambda_s$  and  $\lambda_Q$  are the co-state variables respectively associated with  $\dot{S}$  and  $\dot{Q}$ .

The first order conditions are:

$$\frac{\partial H}{\partial I} = 0 \Leftrightarrow \lambda_s = c'(I) = c_1 I \quad (8)$$

$$\frac{\partial H}{\partial S} = \rho \lambda_s - \dot{\lambda}_s \Leftrightarrow \dot{\lambda}_s = \lambda_s(\delta + \rho) + \lambda_Q(\sigma + \tau \alpha p^{-\varepsilon}) + c_2 - p^{1-\varepsilon} \alpha \quad (9)$$

$$\frac{\partial H}{\partial Q} = \rho \lambda_Q - \dot{\lambda}_Q \Leftrightarrow \dot{\lambda}_Q = \lambda_Q(\tau \beta p^{-\varepsilon} + \rho) - p^{1-\varepsilon} \beta \quad (10)$$

From (5.a), (6.a), (8), (9), (10), we obtain a dynamic system of four linear equations with four unknowns that we solve<sup>9</sup>. We find that the system is converging toward a steady-state value and that this steady-state is a saddle-point.

#### **4. Simulations and economic interpretation of the results**

We have just said that our model is asymptotically converging toward a steady-state value that is a saddle-point. This implies that we have found in a quite simpler model - and considering environmental quality instead of pollution level - the same qualitative result than Kort and al. (2002). But we cannot identify any limit-cycle because the appearance of such a trajectory is the result in Kort and al. (2002) of a complex non-linear formalisation.

Simulations of our model are showing that as a result of the optimal investment policy, the number of tourists evolves as hypothesised by Butler<sup>10</sup>.

First, consider an island initially endowed with little infrastructures and a high environmental quality, it may potentially attract lots of tourists but investment is needed in order to develop the lodging capacity.

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<sup>9</sup> We used the Mathematica 5.2 software for the computation.

<sup>10</sup> See the simulation of the model in annex.

In that case, the lobby will be incited to invest and the profit will be low (may be negative) but increasing as the number of tourists is also increasing.

Anyway, as the investment cost is growing, the number of infrastructures is increasing at a decreasing rate. Further more, as the number of tourists is increasing the pressure on the ecosystem is also increasing .

Because of the increasing costs and of the increasing environmental pressure, in the long run the lobby will be incited to disinvest and then in the long run, will only invest to replace the obsolete infrastructures.

In fact, if the lobby goes on investing in new infrastructures, the result will be a decrease in the environmental quality leading to a dramatic fall in frequentation. But in the meantime the cost of investing and maintaining infrastructures are both increasing. So, in those conditions it is not a rational behaviour to go on investing.

We understand that when the lobby invests, there is an increase in frequentation but as a result of the environmental pressure, we then have a rapid fall in the number of tourists toward the steady-state frequentation, that is a *plateau*. In fact, the optimal investment policy of the lobby leads to the observance of a cycle similar to the one describe by Butler.

The existence of such a mechanism means that the number of tourists that an island would attract is bounded. The upper bound is what is usually called the carrying capacity of a destination.

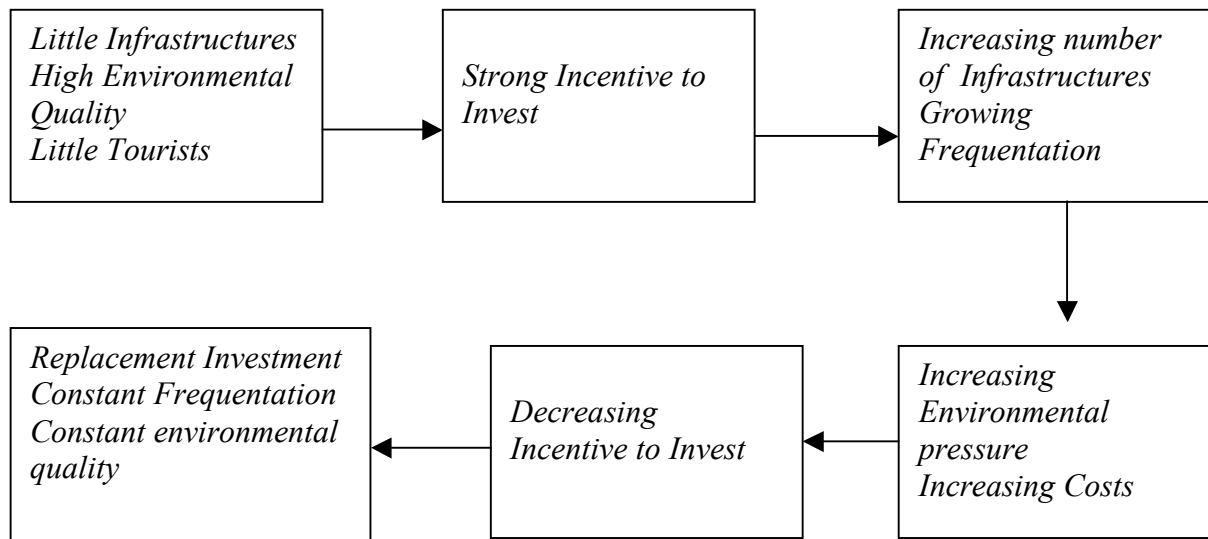
Policy-makers in small tourist islands are often worried because tourist flow is a threat for the conservation of costal areas or even the existence of natural sites. But what our model is saying is that in the long run a minimum level of environmental quality is preserved as the number of tourists visiting the island at each period is constant.

Yet, our analysis also explains what is happening when environmental quality is degraded.

To understand this result, we have to consider that the island has reached a situation characterized by a high number of infrastructures and a poor environmental quality. In such a situation, the number of tourists is declining as the poor environmental quality is taking them away from the island. Then, the lobby is incited to let the number of infrastructures declines in order to save the maintenance costs. So, the island will once more be naturally driven toward the steady-state. Even if our model cannot say more than that, we may suppose that this high number of infrastructures is the result of a past misleading investment policy.

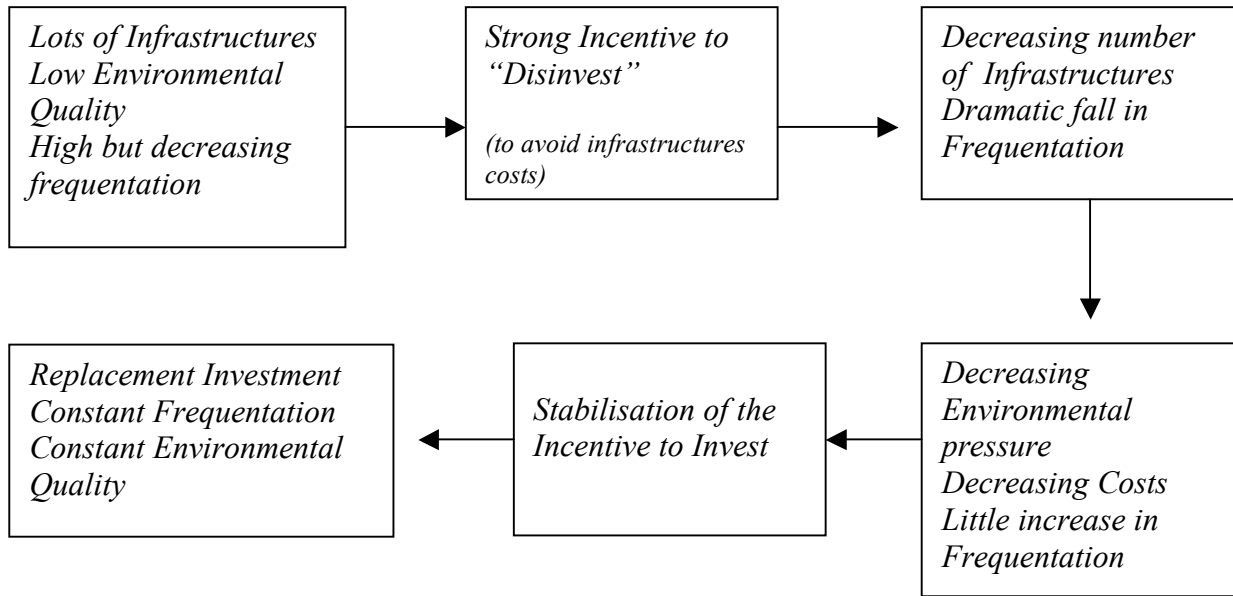
So these two results illustrate the scenario that Butler considered as one of the most plausible, a fall in the number of tourists until it reaches a *plateau*<sup>11</sup>.

**Fig. 2: The developing SITE case**



<sup>11</sup> See trajectory C in fig 1.

**Fig. 3: The over-developed SITE case**



As we are concerned about the profits associated with tourism, we ask for the effect of a change in the price of a journey on the previous results. To say it, in a different way, how an increase or a decrease in the price  $p$  affects *ceteris paribus* the steady-state values of the variables ? What we can say is that the effect of an increase in the price of a journey should be almost compliant with the standard results of environmental economics : as the price increases, the environmental quality is better in the steady-state and there is less infrastructures. The explanation relies on the fact that the number of tourists is lower and this leads to an improvement in environmental quality. If the decline in the number of tourists is not harmful to the profit, a good policy would be to increase the price of a journey. Of course, a necessary condition is that the island has some kind of market power but our model does not allow the exploration of such a scenario.

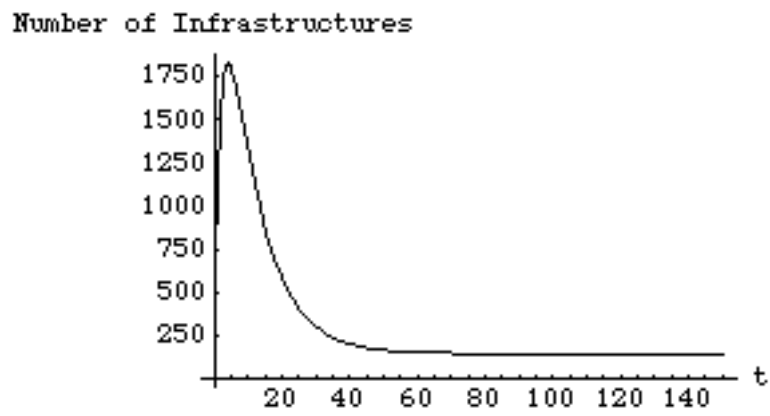
## **5. Conclusion and further research**

The aim of this paper was to explore the inter-temporal trade-off between tourism intensive investments and environmental quality preservation needed to ensure local tourism lobby revenues in the long run. In this perspective, we propose a simple dynamic model of tourism investments introducing the quality of environment “perceived” by tourists as a state variable of the dynamic system. Despite limits inherent to the simplicity of the framework simulations confirm the Butler’s lifecycle hypothesis and the Kort and al. (2002)’s conclusion according to which the competitive tourism industry must limit over time the number of visitors to preserve future profits. The results we obtained tend to show that in the long-run, the maximum number of tourists that a destination is able to welcome is bounded. This is the case because, if the stake-holders disregard the carrying capacity, there will be a dramatic fall in frequentation. Our specific contribution is to show that when the quality of environment is decreasing, tourism lobby may be incited to disinvest in order to preserve environment.

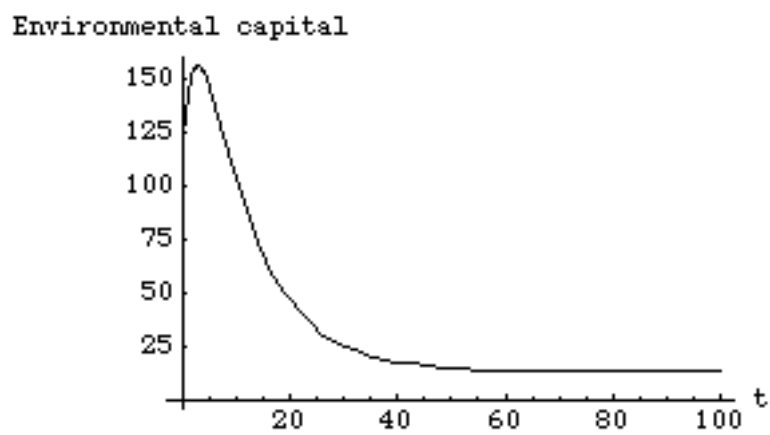
We want to investigate how an increase in the price of a journey would constitute a sustainable way to maintain tourism profits while preserving environment as this price strategy limits the number of the island visitors. As our analysis tends to show a good practice would be for an island to differentiate its product in order to sell it at a price higher than the market price. Introducing a monopolistic competition framework with several destinations competing in tourism industry could be in this perspective one further step of our research.



## **6. Annex: Simulations<sup>12</sup>**



**fig. a : Evolution of infrastructures**



**fig. b: Environmental capital**

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<sup>12</sup> We used the following values of parameters:  $\alpha=\beta=0.5$ ,  $\varepsilon=1.05$ ,  $\delta=0.1$ ,  $\rho=0.03$ ,  $\tau=0.01$ ,  $\sigma=0.05$ ,  $r=0.5$ ,  $p=10$ ,  $c1=0.05$ ,  $c2=0.4$

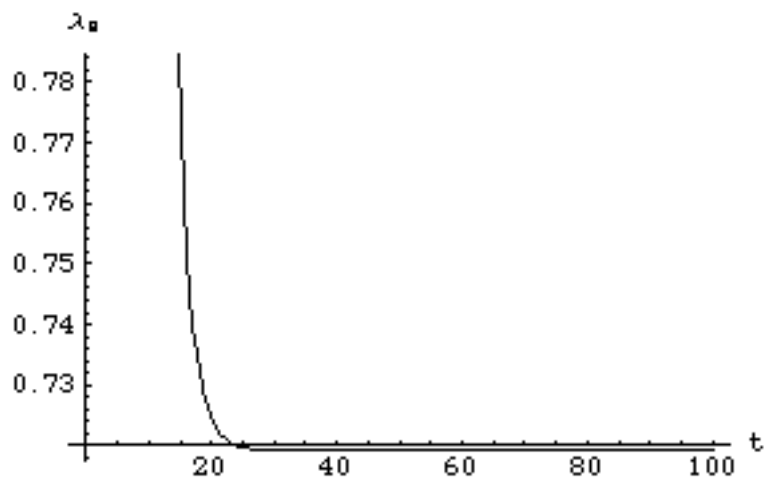


fig. c: Incitation to invest

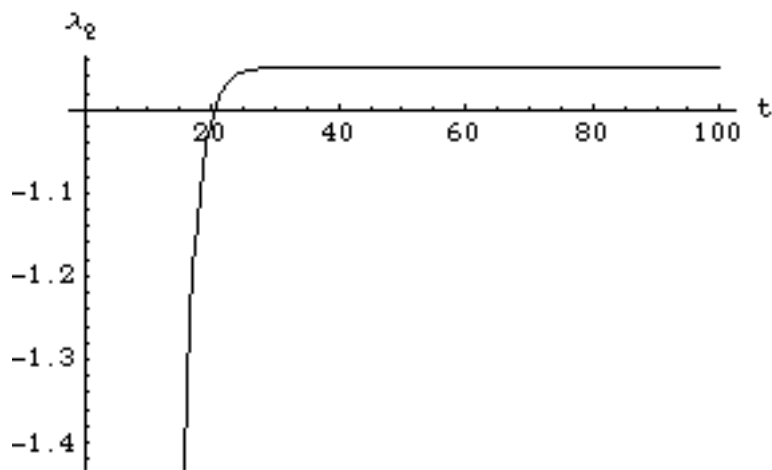


fig. d: Evolution of  $\lambda_Q$

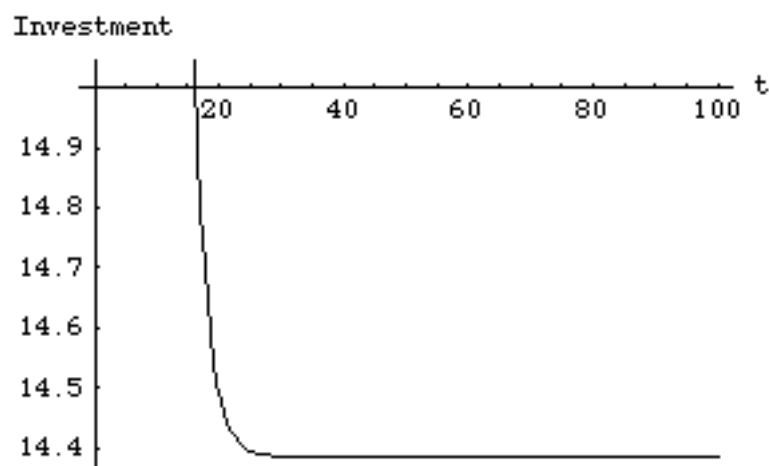
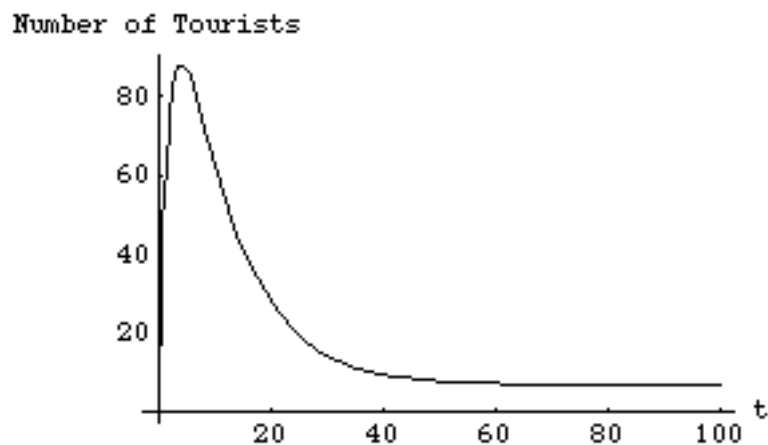
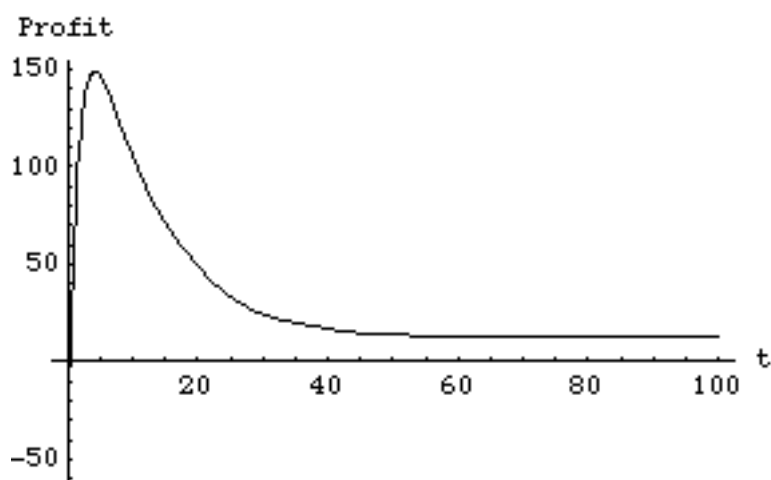


fig. e: Evolution of Investment



**fig. f: Number of tourists**



**fig. g: Instantaneous Profit**

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- (lxv) This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications” organised by Fondazione Eni Enrico Mattei and sponsored by the EU, Milan, September 25-27, 2003
- (lxvi) This paper has been presented at the 4<sup>th</sup> BioEcon Workshop on “Economic Analysis of Policies for Biodiversity Conservation” organised on behalf of the BIOECON Network by Fondazione Eni Enrico Mattei, Venice International University (VIU) and University College London (UCL) , Venice, August 28-29, 2003
- (lxvii) This paper has been presented at the international conference on “Tourism and Sustainable Economic Development – Macro and Micro Economic Issues” jointly organised by CRENoS (Università di Cagliari e Sassari, Italy) and Fondazione Eni Enrico Mattei, and supported by the World Bank, Sardinia, September 19-20, 2003
- (lxviii) This paper was presented at the ENGIME Workshop on “Governance and Policies in Multicultural Cities”, Rome, June 5-6, 2003
- (lxix) This paper was presented at the Fourth EEP Plenary Workshop and EEP Conference “The Future of Climate Policy”, Cagliari, Italy, 27-28 March 2003
- (lxx) This paper was presented at the 9<sup>th</sup> Coalition Theory Workshop on "Collective Decisions and Institutional Design" organised by the Universitat Autònoma de Barcelona and held in Barcelona, Spain, January 30-31, 2004
- (lxxi) This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications”, organised by Fondazione Eni Enrico Mattei and Consip and sponsored by the EU, Rome, September 23-25, 2004
- (lxxii) This paper was presented at the 10<sup>th</sup> Coalition Theory Network Workshop held in Paris, France on 28-29 January 2005 and organised by EUREQua.
- (lxxiii) This paper was presented at the 2nd Workshop on "Inclusive Wealth and Accounting Prices" held in Trieste, Italy on 13-15 April 2005 and organised by the Ecological and Environmental Economics - EEE Programme, a joint three-year programme of ICTP - The Abdus Salam International Centre for Theoretical Physics, FEEM - Fondazione Eni Enrico Mattei, and The Beijer International Institute of Ecological Economics
- (lxxiv) This paper was presented at the ENGIME Workshop on “Trust and social capital in multicultural cities” Athens, January 19-20, 2004
- (lxxv) This paper was presented at the ENGIME Workshop on “Diversity as a source of growth” Rome November 18-19, 2004
- (lxxvi) This paper was presented at the 3rd Workshop on Spatial-Dynamic Models of Economics and Ecosystems held in Trieste on 11-13 April 2005 and organised by the Ecological and Environmental Economics - EEE Programme, a joint three-year programme of ICTP - The Abdus Salam International Centre for Theoretical Physics, FEEM - Fondazione Eni Enrico Mattei, and The Beijer International Institute of Ecological Economics
- (lxxvii) This paper was presented at the Workshop on Infectious Diseases: Ecological and Economic Approaches held in Trieste on 13-15 April 2005 and organised by the Ecological and Environmental Economics - EEE Programme, a joint three-year programme of ICTP - The Abdus Salam International Centre for Theoretical Physics, FEEM - Fondazione Eni Enrico Mattei, and The Beijer International Institute of Ecological Economics.
- (lxxviii) This paper was presented at the Second International Conference on "Tourism and Sustainable Economic Development - Macro and Micro Economic Issues" jointly organised by CRENoS (Università di Cagliari and Sassari, Italy) and Fondazione Eni Enrico Mattei, Italy, and supported by the World Bank, Chia, Italy, 16-17 September 2005.

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