Environmental and Tourism Policy in a Dynamic Model of an Economy Specialized in Tourism[1]

Carlos Mario Gómez Gómez

Department of Economics and Economic History, University of Alcalá de Henares, Madrid, Spain

Javier Lozano Ibáñez

Department of Applied Economics, University of the Balearic Islands, Spain

Javier Rey-Maquieira Palmer

Department of Applied Economics, University of the Balearic Islands, Balearic Islands, Spain

We construct a dynamic general equilibrium model for an economy specialized in tourism to explore long term effects of some environmental and tourism policies. We show the conditions for a double dividend after a green tax reform where the environmental tax is a night stay tax. These conditions depend on the initial level of environmental quality and tourism preferences. Moreover, we compare the long term effects of two alternative policy instruments, that is, the night stay tax and a quality standard imposed to the tourism firms. We show that both instruments have different effects on the incentives to accumulate capital. From a long term perspective, the quality standard is always better that the night stay tax provided that the former does not cause dynamic inefficiency.

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1. INTRODUCTION

Tourism has been one of the fastest growing sectors during the last decades and it has become one of the main sectors at the world level. Including direct and indirect effects, nowadays the travel and tourism sector accounts for 10.2% of world GDP, 11.8% of world exports and 9.6% of world investment (WTTC [26]). In spite of the uncertainties generated by the 11-S, tourism growth forecasts for the following years are still favorable. Thus, according to the World Travel and Tourism Council over the next ten years world's travel and tourism real GDP is expected to increase at a 3.6% annualized growth rate, exports at a 7.1% and capital investment at a 4.3%. Tourism expansion has been specially intensive in some national and regional economies that have follow a process of specialization in this sector. Particularly in some small economies, with low possibilities of diversification, the tourism sector has attracted the most part of productive resources. For these economies tourism has become an opportunity for development and improvement of living standards. Some works as Balaguer and Cantavella-Jordá [2], Lanza and Pligiaru [17], Adams and Parmenter [1] or Copeland [11] have explored from different points of view the role of tourism as an engine for economic growth.

In many cases the specialization in tourism has been triggered by the abundance of natural resources with tourism attractiveness. The tourism sector has a distinctive relationship with the environment, both of dependence and impact (Tisdell [25]). The natural environment is part of the tourism output, but tourism activity exerts a high pressure on nature (Davies and Cahill [12]) which may harm the welfare of residents and even put in danger the tourism viability of the economy. Most of the environmental damages are external costs giving way to an excessive tourism expansion form the social point of view.

During the last years the environmental impact of tourism has become a source of concern in economies which heavily rely in this sector and the convenience of implementing public measures to correct environmental damages has been put forward.

In fact, the increasing importance of tourism has triggered an interest in public intervention motivated by several reasons. Frequently the tourism sector has been seen as an attractive source of tax revenues given the large amount of income that it generates and the possibility of shifting the tax burden to foreigners. Sometimes the public intervention has been aimed to change the sectoral structure of the economy, be it through the promotion of the whole sector or through the promotion of certain tourism models that are considered socially desirable. For instance, some tourism economies strive for a change of the pattern of specialization from the mass tourism to a "quality" tourism, considered this as a kind of tourism supply that attracts high income visitors. In some cases as well, there is a demand for public intervention to correct the externalities generated by the tourism sector.

To reach these targets several policy instruments have been used such as tourism taxes (room taxes, entry taxes, exit taxes and so on), quality requirements imposed to the suppliers of tourism services or the provision of public infrastructures related to the tourism activity. Tourism taxes have seldom been used as environmental taxes except for the case when the tax revenues have been earmarked to the improvement of environmental and natural resources. However, it is well known that what makes a tax "environmental" is not the use of the public revenues that it raises but its effects on the activity that exerts an environmental damage. We believe that too little attention has been devoted to the degree of complementarity between the objectives of public intervention and the general equilibrium effects of the policy instruments commented above. Regarding these issues, several questions arise. For instance, what are the environmental effects of policies aimed at the quality improvement of the tourism services?; is "quality" tourism more environmentally friendly than mass tourism?; may the tourism taxes be used as environmental taxes?; what is the best use of the public revenues raised from the tourism taxes?; which is the set of policies that allows for a higher social welfare in an economy specialized in tourism?

In this paper we develop a dynamic general equilibrium model for a small economy specialized in tourism where the expansion of the tourism sector is the engine of growth and where we include the relationship of dependence and impact between the tourism activity and the environment. Methodologically the model is related to a body of the literature that extends economic growth theory to include environmental variables (Tahvonen and Kuuluvainen [24], Stokey [23], Hettich [14], among others). However, to our knowledge this is the first work that analyses the relationship between tourism activity and the environment in a dynamic general equilibrium model. In this framework, we explore the effects of some tourism-environmental policies. Specifically, a night stay tax and a quality standard for the tourism firms. The empirical counterparts to the night stay tax are some tax instruments that have been increasingly used and that have been labeled in several ways: room tax, bednight tax or bed tax. These are taxes that tourists have to pay for receiving accommodation services in a given location. Given the generality of the model, the night stay tax could also be a proxy for entry or exit taxes. Generally, the night stay tax try to represent any tax that is paid for the very act of staying in a given tourism resort. As the model is set up, the night stay tax plays a role as an environmental tax. Given this, we explore the conditions for a double dividend in the context of a "green" tax reform. There is already a large body of the literature that analyses the conditions for a double dividend (Bovenberg and de Mooij [6]; Goulder [13], among others) but few papers set the analysis in a dynamic context (an exception is, for instance, Bovenberg and de Mooij [7]) and, as far as we know, none has done it for the case of economies specialized in tourism.

The rest of the paper is organized as follows. Section 2 discusses the model. Section 3 explores the long term effects of a night stay tax. Specifically, the analysis focuses on the long term effects of marginal changes in that instrument, with special attention to the conditions for the existence of a double dividend. Section 4 compares two policy instruments in terms of the consequences for long term welfare: the night stay tax and a quality standard for the tourism firms. Finally, section 5 concludes.

2. THE MODEL

We consider the case of a small open economy that is fully specialized in providing tourism services to foreigners. There are a large number of identical tourism firms that operate in perfect competition. Each firm provides all the private tourism services that their clients demand using capital as the only factor of production.[2]

2.1. Tourism preferences and tourism revenues

A visitor obtains satisfaction from three different sources:

a) Tourism services provided by the tourism firms. We consider capital relative to the capacity of accommodation as a quality index form the tourism firm, that is, K_i/T_i, where K_i is the capital of the firm i and T_i is its capacity of accommodation. The satisfaction of a tourist depends positively on this quality index.

b) Goods and services provided by the public sector. The public sector provides goods and services such as security, maintenance of public areas, transportation and leisure infrastructures and so on that enhances the perceived quality of a tourism resort and the satisfaction of visitors. We allow for the fact that these goods and services may differ in terms of their local or non-local use. Actually, some goods and services provided by the public sector are mainly for the use of those tourists that lodge in a specific area. However, the public sector also provides goods and services for the whole tourism industry.[3] Although we acknowledge that there is a continuum between pure local and pure non-local goods and services, for simplicity we only consider two kinds of goods and services provided by the public sector. On the one hand, each firm receives goods and services that are for the exclusive use of their clients. On

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[2] It could be interpreted as physical capital or as a broader measure that also includes human capital.

[3] A public car park next to a hotel would fall into the first category; an airport into the second.

the other hand, the public sector provides goods and services that are non-excludable. Let us call the first kind of goods and services G_A and the second G_B. We assume that both types are subject to congestion.

c) Environmental quality of the resort. In many tourism resorts natural assets are an essential part of the tourism product and as such a key determinant of the visitors' satisfaction.[4] We consider that environmental quality is represented by a single variable called N.[5]

Given these assumptions we define a utility function that measures the satisfaction per night stay of a tourist that visits the resort:

$$U_i^T = U^T\left(\frac{K_i}{T_i}, \frac{G_B}{\vartheta T}, \frac{G_{Ai}}{\vartheta T_i}, N\right)$$

where U^T_i is the utility of a tourist that receives services from firm i, G_{Ai} are excludable goods and services that firm i receives from the public sector, T is the aggregate accommodation capacity of the resort and ϑ is the number of night stays per unit of accommodation capacity, which is treated as a constant. We assume that utility is increasing in each of its arguments and the second derivatives are negative. All the tourists share the same utility function. Expression (1) could be also interpreted as a composite index for the tourism services' quality that includes specific characteristics of the tourism firm as well as general traits of the resort. In the following, we use a Cobb-Douglas form of the previous utility function:

$$U_i^T = \left(\frac{K_i}{T_i}\right)^{\alpha}\left(\frac{G_B}{\vartheta T}\right)^{\beta}\left(\frac{G_{Ai}}{\vartheta T_i}\right)^{\gamma} N^{\mu} \qquad (1)$$

[4] Works like Riera [20] reveal the importance of the environmental assets in tourism preferences.

[5] Arguably the environmental assets could also differ in terms of their local or non-local nature.

where we assume that $\alpha, \beta, \gamma \in (0,1)$; $\mu>0$; $\alpha+\beta+\gamma<1$

From (1) we can obtain the revenues that accrue to a firm given additional assumptions. Firstly, we define P_U as the price a tourist is willing to pay for a unit of satisfaction obtained in the resort. In the following we assume that manufactures are the numeraire and therefore P_U is the price of tourism relative to manufactures (the former measured in terms of satisfaction). Given this, the price paid for the tourism services is:

$$P_i^T = P_U U_i^T$$

Let us assume that P_U is exogenously determined in the international markets. Notice that although international competition fixes the price for a given quality of the services, a firm could charge a higher price provided that its services are considered of a higher quality than competitors'. To put it differently, in the international economy there is a continuum of tourism markets differentiated by their quality and the price paid for the tourism services. In each of them the suppliers are price-takers but they can move along the quality ladder either due to their own decisions or due to changes in the characteristics of the tourism resort where they are located.

Secondly, and given that the number of night stays in the tourism firm is ϑT_i, revenues of a firm i are:

$$TR_i = \phi T_i^{1-\alpha-\gamma} K_i^{\alpha} \left(\frac{G_B}{T}\right)^{\beta} G_{Ai}^{\gamma} N^{\mu} \quad (2)$$

where $\phi=\vartheta^{1-\beta-\gamma}P_U$

An aggregate revenue function can be constructed under the assumption that all the firms receive the same amount of excludable goods and services from the public sector. Given this, all the firms hire the same amount of capital per unit of accommodation capacity and have the same amount of excludable goods and services received from the public sector per night stay.[6] Therefore, $K_i/T_i= K/T$, $G_{Ai}/\vartheta T_i= G_A/\vartheta T$, where $K=\Sigma K_i$, $G_A=\Sigma G_{Ai}$. As a consequence, price per night stay is the same for all the firms of the tourism resort, $P^T_i=P^T\ \forall\ i$. Aggregate revenues are thus:

$$TR=\phi T^{1-\alpha-\beta-\gamma}K^{\alpha}G_B^{\beta}G_A^{\gamma}N^{\mu} \tag{2'}$$

Higher accommodation capacity increases tourism revenues. Revenues can also be increased if the attractiveness of the resort is enhanced through higher capital and public expenditure per unit of accommodation capacity or higher environmental quality.

2.2. Public sector

The public sector raises revenues using two instruments. An ad valorem tax levied on tourism revenues, τ_{TR}, $0\leq\tau_{TR}<1$ and a specific night stay tax, τ_T, $\tau_T\geq 0$. Public budget is always in equilibrium, that is:

$$\tau_{TR}TR+\tau_T T=G_A+G_B+F \tag{3}$$

where we allow for lump-sum transfers, F, and ϑ is normalized to one.

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[6] This is ensured by first order conditions for the firm.

2.3. Firms' behavior

Firms maximize profits hiring capital and taking decisions over their accommodation capacity. Both decisions determine the quality of services provided by the firm, K_i/T_i. Firms take as given the amount of goods and services provided by the public sector, environmental quality and aggregate accommodation capacity of the resort. Notice that the model allows for two kind of investment. Investment in quality takes place when the firm increases its capital without modifying its accommodation capacity. However, when accommodation capacity is raised in the same proportion as capital we can speak of investment in capacity.

Two conditions follow from profit maximization:

$$(1-\tau_{TR})\alpha\frac{TR}{K}=R \tag{4}$$

$$(1-\tau_{TR})(1-\alpha-\gamma)\frac{TR}{T}=\tau_T \tag{5}$$

Aggregate profits are:[7]

$$\Pi=(1-\tau_{TR})\gamma TR \tag{6}$$

2.4. Residents' behavior

[7] Formally, profits are due to diminishing returns to scale at the firms' level. We can consider that these profits accrue to some fixed factors (e.g. land, know-how) that act as a barrier for entering firms and allow for the existence of profits in the equilibrium (see Bovenberg and de Mooij [7]).

Residents are modelized as a single representative agent that maximizes the following intertemporal utility function:

$$\omega_0 = \int_0^\infty e^{-\rho t} \frac{\left(C_t N_t^v\right)^{1-\theta}}{1-\theta} dt \qquad v,\ \rho,\ \theta>0$$

where θ is the constant intertemporal elasticity of substitution, ρ is the rate of time preference and v is a relative weight of environmental quality on residents' preferences, that is, $v=(\partial U/\partial N)N/(\partial U/\partial C)C$. Residents take utility from environmental quality and from the consumption of manufactures, C. Therefore, residents do not make use of local tourism services. For simplicity we do not consider a direct effect of goods provided by the public sector on residents' utility.

Residents own all the factors of production. For simplicity we rule out international financial flows.[8] Therefore, the following expressions determine the behavior of residents:

$$\dot{K} = rK + \Pi + F - C \tag{7}$$

$$\frac{\dot{C}}{C} = \frac{1}{\theta}\left[r - \rho + v(1-\theta)\frac{\dot{N}}{N} \right] \tag{8}$$

$$\lim_{t\to\infty} \lambda_t K_t = 0 \tag{9}$$

where r is net real rate of return and λ is a co-state variable associated with capital.

[8] The main results of this paper would not change if the economy can borrow to finance only a portion of its capital in the same fashion as Barro *et alt.* [3].

2.5. Trade flows and terms of trade

Given our assumptions, the economy "exports" the whole tourism services that produces in exchange for manufactures. Given that manufactures are the numeraire and if we take a night stay as the unit measure for the tourism services, terms of trade are:

$$RRI = P^{T} = P_{U}U^{T} = P_{U}\vartheta^{-\gamma-\beta}T^{-\alpha-\beta-\gamma}K^{\alpha}G_{A}^{\gamma}G_{B}^{\beta}N^{\mu} = {}^{TR}\!/_{\vartheta T}$$

Changes in environmental quality and changes in capital or public expenditure per unit of accommodation capacity trigger changes in the terms of trade.

2.6. Environmental quality

We interpret environmental quality as a renewable resource. 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 [12] give an account of the environmental impacts of tourism such as energy consumption, water consumption, wastes, impacts on water and air quality, ecosystems alteration and fragmentation, impacts on wildlife and on aesthetic and cultural environment. The intensity of those impacts are closely related to the number of visitors and the building of facilities for their lodging and recreational activities.

We assume that environmental quality evolves over time according to the following function:

$$\dot{N} = \varsigma(\overline{N} - N) - zT \tag{10}$$

For simplicity we have considered a linear regeneration function. $\overline{N}$ is the maximum level of environmental quality, ς is the rate of recovery of the environment due to natural regeneration and z measures the environmental impact associated with a unit of accommodation capacity. Given this specification, investment in capacity has a negative impact on the environment but investment in quality (higher capital for a given capacity of accommodation) has not. We do not differentiated the environmental impact of different types of tourism. For instance, the differences in habits and behavior of tourists with different socio-economic characteristics may imply differences in their environmental impact. Therefore, a change from mass tourism to "quality" tourism would not only affect the environment through the amount of tourists (assumedly in a positive way) but also from a change in z. A constant z is therefore a simplification only justified by our lack of evidence about the magnitude and even the sign of the change in z when the composition of visitors changes.

2.7. Equilibrium

Before solving for the equilibrium, the dynamic behavior of the model deserves some comments. The engine of growth in this economy is capital accumulation, but growth eventually stops. To see this more clearly let us consider that public expenditure is a constant fraction of tourism revenues. In this case tourism revenues are:

$$TR = \left(\phi s_B^{\beta} s_A^{\gamma}\right)^{1/1-\gamma-\beta} T\left(\frac{K}{T}\right)^{\alpha/1-\gamma-\beta} N^{\mu/1-\gamma-\beta}$$

where $s_A = G_A/TR$ and $s_B = G_B/TR$.

Two characteristics of the model rule out an unlimited growth based on capital accumulation. Firstly, investment in quality exhibits decreasing returns due to the characteristics of tourism preferences.

Secondly, for a constant environmental quality, investment in capacity (that is, increases of capital and accommodation capacity in the same proportion) would raise tourism revenues proportionally. However, the investment in capacity harms the environmental attractiveness of the resort and, therefore, reduces the returns to capital in the tourism sector. Therefore, in the model there are upper limits to the accommodation capacity of the resort base on the existence of a fixed natural base. This trait accords with a stylized fact stressed by a body of the tourism literature that is, the existence of a carrying capacity of the tourism resorts (see Butler [10] or Hunter and Green [15], among others).[9]

We can solve for the equilibrium combining (3), (4), (5), (6), (7), and (8) and considering $r=R-\delta$, where δ is the rate of capital depreciation. Then we obtain:

$$\frac{\dot{C}}{C}=\frac{1}{\theta}\left[\alpha(1-\tau_{TR})\frac{TR}{K}-\delta-\rho+v(1-\theta)\frac{\dot{N}}{N}\right] \tag{11}$$

$$\dot{K}=TR-G_A-G_B-\delta K-C \tag{12}$$

Equations (2'), (5), (9), (10), (11) and (12) describe the dynamic behavior of *C, K, TR, T* and *N* given a path for the policy variables. The model has a stationary state where: [10]

$$\dot{N}=\dot{K}=\dot{C}=\dot{G}_A=\dot{G}_B=\dot{TR}=\dot{T}=\dot{\tau}_T=\dot{\tau}_{TR}=\dot{F}=0$$

[9] A key question is whether it is possible for tourism revenues, consumption and welfare to continue to grow after the resort having reached its carrying capacity. In this model this is not possible, at least endogenously, given decreasing returns to investment in quality. This is, however, a matter of great interest in economies that are specialized in tourism and it deservers further research.

[10] Stability of the steady state is discussed in appendix A.

and:

$$N = \left[\frac{1}{\phi} \left(\frac{\delta + \rho}{\alpha} \right)^{\alpha} \left(\frac{\tau_T}{1 - \alpha - \gamma} \right)^{1-\alpha-\beta-\gamma} \left(\frac{1}{1 - \tau_{TR}} \right)^{1-\beta-\gamma} \left(\frac{1}{s_A} \right)^{\gamma} \left(\frac{1}{s_B} \right)^{\beta} \right]^{\frac{1}{\mu}} \tag{13}$$

$$T = \frac{\varsigma(\overline{N} - N)}{z} \tag{14}$$

$$TR = \frac{\tau_T}{(1 - \tau_{TR})(1 - \alpha - \gamma)} T \tag{15}$$

$$K = \frac{(1 - \tau_{TR})\alpha}{\delta + \rho} TR \tag{16}$$

$$C = (1 - s_A - s_B) TR - \delta K \tag{17}$$

3. LONG TERM EFFECTS OF THE NIGHT STAY TAX

In this section we explore the effects of marginal changes in the night stay tax on the long term values of the economic and environmental variables. With such an aim, we express the stationary state in terms of relative changes of the variables:[11]

$$\hat{TR} = \varepsilon \hat{T} + \alpha \hat{K} + \gamma \hat{G}_A + \beta \hat{G}_B \tag{19}$$

$$\hat{TR} - \hat{\tau}_{TR} = \hat{K} \tag{20}$$

$$\hat{N} = -[(\overline{N} - N)/N] \hat{T} \tag{21}$$

[11] A hat denotes a relative change, that is, $\hat{x} = dx/x$. For simplicity we focus on the steady state. A more complete analysis should also consider transitional effects.

$$\hat{TR} - s_A \hat{G}_A - s_B \hat{G}_B - \delta s_K \hat{K} = s_C \hat{C} \qquad (22)$$

$$\hat{TR} - \hat{\tau}_{TR} = \hat{T} + \hat{\tau}_T \qquad (23)$$

$$(1-\tau_{TR})\hat{\tau}_{TR} + \tau_{TR}\hat{TR} + \hat{\tau}_T \tau_T^* + \hat{T}\tau_T^* = s_A \hat{G}_A + s_B \hat{G}_B + s_F \hat{F} \qquad (24)$$

where (19), (20), (21), (22), (23), (24) come from (2'), (16), (14), (17), (15) and (3) respectively and where:

$$\varepsilon = (1-\alpha-\beta-\gamma) - \mu \frac{\overline{N} - N}{N}$$

$$\hat{\tau}_{TR} = d\tau_{TR}/(1-\tau_{TR}) \qquad \tau_T^* = \tau_T T/TR$$

$$s_K = K/TR \qquad s_C = C/TR \qquad s_F = F/TR$$

The variable ε is the elasticity of tourism revenues with respect to accommodation capacity. Notice that ε is a general equilibrium elasticity that captures all the effects of a change in accommodation capacity on tourism revenues.

3.1. Long term effects: general discussion

Given that the public budget is always in equilibrium, policy changes require the modification of at least two instruments. Therefore, the effects of changes in τ_T depend on the policy instrument used to keep the public budget balanced. We analyze three alternatives. In the first one, the public budget is kept balanced using lump-sum transfers, in the second, using public expenditure, in the third, using the revenue tax. Table I shows the effects of a marginal change of the night stay tax for the three scenarios.[12]

[12] Results in the table 1 are obtained in appendix B.

Table I has been constructed under the assumption that before the policy change $s_A=\gamma$ and $s_B=\beta$. In the second and third scenarios it is also assumed that $F=0$.[13] Finally, in the second scenario both types of public expenditure change in the same proportion. The following results hold for the three cases:

(i) A marginal increase in the night stay tax reduces accommodation capacity and raises capital per unit of accommodation capacity (quality of tourism firms). Table II disaggregates the effect on accommodation capacity. An increase in the night stay tax raises the cost of capacity investment relative to quality investment and thus capital per unit of accommodation capacity increases (see row 9 in table I). The second term in any of the expressions in table II shows the effect of the change in K/T on accommodation capacity. The effect on accommodation capacity will also depend on the behavior on aggregate capital, which is the first term of any of the expressions of table II. Capital could increase or decrease, depending on the sign of ε, but the overall effect on accommodation capacity is negative as it is shown in column 4 of table I.

(ii) A marginal increase in the night stay tax improves environmental quality (row 5 of table I) and the terms of trade (row 10 of table I).

(iii) A marginal increase in the night stay tax increases (reduces) tourism revenues (row 6 in table I), capital (row 7 in table I) and consumption (row 8 in table I) if the elasticity of tourism revenues with respect to accommodation capacity is negative (positive). Moreover a negative (positive) elasticity implies a reduction (increase) in the revenue tax when this is the policy instrument used to keep the public budget balanced (first row in table I).

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[13] When $s_A=\gamma$ and $s_B=\beta$, marginal revenues of public expenditure equal the resources needed to finance an additional unit of public expenditure. Therefore, this assumption means that we rule out distortions associated with inefficient levels of public expenditure. Nevertheless, the results in the first and second columns are valid for any value of s_A and s_B between cero and one. Results in the first column do not depend on the initial value of the lump-sum transfers. Finally, results in the second column hold if $F\neq 0$ provided that lump-sum transfers experience the same relative change as public expenditure.

3.2. Double dividend

One of the interesting results of the previous analysis is that, under certain conditions, the increase in the night stay tax yields a double dividend for the residents, that is, not only an increase in long term environmental quality but also higher long term consumption and non-environmental welfare.[14] Regarding the double dividend, three issues deserve further analysis. Firstly, given our functional form for the regenerative capacity of the environment, it can be shown that there is a threshold of environmental quality that determines the effects of the policy change on long term consumption:

$$\varphi = \frac{N}{\overline{N}} = \frac{\mu}{1-\alpha-\beta-\gamma+\mu}$$

If initial environmental quality is below this threshold, the elasticity of tourism revenues with respect to accommodation capacity is negative and therefore, an increase in long term consumption results from the policy change. However, when initial environmental quality is high enough, the improvement of the environment has a cost in terms of consumption. Notice that this threshold only depends on the tourists preferences. Specifically, the threshold will be higher the higher are the elasticities of tourism revenues with respect to the environmental quality, public expenditure and capital. Intuitively, an increase in the night stay tax reduces accommodation capacity, which has a quantitative negative effect on tourism revenues. However, it also enhances the attractiveness of the resort through higher environmental quality and capital per unit of accommodation capacity and lower congestion in the use of goods and services provided by the public sector. The magnitude of this later effect depends positively on the elasticities of tourism revenues with respect to the environmental quality, public expenditure and capital. To be larger

[14] This is what Goulder [13] calls the strong double dividend.

that the negative effect, long term environmental quality should be elastic enough with respect to the accommodation capacity. Given a linear regeneration function, this elasticity is large (low) when initial environmental quality is low (large).

Secondly, notice that the second dividend can take place whichever is the instrument used to keep the public budget balanced. This is in contrast to most of the literature on the second dividend, where the only channel through which an environmental tax reform can yield an improvement in material consumption is the reduction in distortionary taxes (the revenue tax in this model). Our result is due to the inclusion of a second channel through which the green tax reform can yield a second dividend, that is, the positive effect of the environmental quality on tourism revenues. This raises the question of what is the contribution of the revenue tax in the second dividend. In order to answer this question, we compare the second dividend in two of the previous scenarios, that is, in the case the revenue tax is used to keep the public budget balanced and in the case the lump-sum transfers make the work. In this later case only the second channel is present since the use of the additional public revenues is neutral. In both scenarios we consider the case when the elasticity of tourism revenues with respect to accommodation capacity is negative.

This comparison can be performed calculating the marginal excess burden in the steady state, that is, the additional consumption that is needed to maintain steady state utility level unchanged after the policy change. Marginal excess burden can be expressed as:[15]

$$\frac{d\hat{\lambda}}{C} = v\frac{\overline{N}-N}{N}\hat{T} - \frac{1}{s_C}\left[\alpha - \delta\frac{\alpha(1-\tau_{TR})}{\delta+\rho}\right]\left(\hat{K}-\hat{T}\right) - \frac{1}{s_C}\left[1-\delta s_K - \beta - \gamma - \mu\left(\overline{N}-N\right)/N\right]\hat{T}$$

[15] See appendix C.

where we have assumed that $s_A=\gamma$ and $s_B=\beta$ before the policy change. $d\tilde{\lambda}/C$ is the relative change in consumption needed to hold utility constant after the policy change. A positive value of $d\tilde{\lambda}/C$ reveals a decrease in long term welfare while a negative value means that the policy change improves long term welfare.

The first term is the direct effect on utility due to a higher environmental quality, that is, the first dividend. The first dividend always reveals a positive effect on long term welfare for any initial value of environmental quality and for any of the three scenarios since an increase in the night stay tax always reduces accommodation capacity.

The rest of the marginal excess burden is the second dividend. The increase in log-term consumption is divided between that part that is attributable to the change in capital per unit of accommodation capacity (that is, the quality of tourism firms) and that part due to the change in accommodation capacity. The first effect is the same in both scenarios in sign (positive effect on welfare) and magnitude (see row 9 in table I).[16] Regarding the second effect, we should consider that an increase in the night stay tax reduces accommodation capacity in both scenarios and therefore the second effect contributes to an increase in consumption if $N/\overline{N} < \psi$ and to a fall in consumption if $N/\overline{N} > \psi$, where:[17]

$$\psi = \frac{\mu}{1-\delta s_K - \beta - \gamma + \mu}$$

It can be shown that the fall in accommodation capacity is smaller when the revenue tax is reduced than when lump-sum transfers are used (see row 4 in table I). What follows from this analysis is that the reduction in the revenue tax exerts a negative effect on welfare if initial environmental quality is low (specifically, if $N/\overline{N} < \psi$) and contributes positively to the second dividend if the quality of the

[16] There is no effect if $\tau_{TR}=\rho=0$. In this case capital in the steady state equals its golden rule level.

[17] Notice that $\psi<\varphi$ since $\delta s_K<\alpha$.

environment is sufficiently high (if $N/\bar{N} > \psi$). This may seem a puzzling result if it is considered that the revenue tax reduces the incentives to accumulate capital. However, it must be taken into account that the base of the revenue tax is the whole tourism revenues and thus this tax also reduces the incentives to provide accommodation services. Therefore, the tax levied on tourism revenues plays a role, although imperfect, in reducing the environmental impact of tourism activity. When the night stay tax is very low (this is the case when the environment is badly damaged) it is good, in terms of long term consumption, to keep the revenue tax constant in spite of its distortionary effects on the supply of capital. Only when the night stay tax is large enough and therefore the revenue tax is less necessary to correct the environmental externalities it is better to correct the distortions on capital accumulation caused by the revenue tax.[18]

Finally, it is interesting to focus on the role of the terms of trade in the effects of a change in the night stay tax. Remember that P^T, that is, the price per night stay, is the price of exports relative to imports and therefore it can be interpreted as the terms of trade of the economy. An increase in the night stay tax always improve the terms of trade and this effect will be stronger than the quantitative negative effect when the elasticity of the tourism revenues with respect to the accommodation capacity is negative. Therefore, the improvement in the terms of trade is a necessary condition for a positive second dividend to take place. This property of the model links this paper with previous work. On the one hand, works as Copeland [11] or Nowak and Sahli [18] that build static general equilibrium models stress the role of the terms of trade in the effects of an increase in the demand for tourism services. On the other hand, Smulders [22] and Sen and Smulders [21] show how improvements in the terms of trade can trigger a second dividend in the context of a “green” tax reform. In these papers the economy has market power in the international market. The environmental tax acts as a tax on exports, which improves the

[18] Since $\psi<\varphi$, it could be said that there are situations when there is a strong double dividend but not a weak double dividend in Goulder’s [13] terminology.

terms of trade. Through this channel, the economy is able to make the foreigners bear the burden of the environmental tax and therefore, the increase of welfare for the residents comes at the expense of non-residents' welfare. In our model the improvement in the terms of trade obey to a different reason. The economy lacks market power in the sense that for a given level of quality of its tourism product it has to accept an exogenous price. Therefore, a reduction in the tourism supply of the resort would not have any effect on its terms of trade if no impact on the attractiveness of the resort would take place. It is the positive effect on the tourists satisfaction stemming from the tax reform that allows for an improvement in the terms of trade and therefore the increase in welfare for the residents does not take the form of a transfer from abroad.

As a corollary, the model shows that the environmental policy may trigger an improvement in log-term competitiveness if as such we understand an increase in the terms of trade that leads to higher welfare.[19] Therefore, we show that in the tourism sector there is room for the Porter hypothesis to be met (Porter and van der Linde [19]), that is, the environmental regulation can induce an improvement in competitiveness and welfare.

4. NIGHT STAY TAX AND QUALITY STANDARDS

In this section a comparison is done between the effects of the night stay tax an a quality standard. The comparison is made for the long term equilibrium. We define a quality standard as a minimum of capital per unit of accommodation capacity imposed to the tourism firms by the public sector. In some economies based on mass tourism, concern has been expressed about the convenience of improvements in the quality of the services provided by the tourism firms. Of course "quality" has many dimensions and it is not only determined by the amount of capital per unit of accommodation capacity. However, if

[19] The concept of competitiveness is a matter of controversy but, as Krugman [16] or Boltho [4] say, long term competitiveness is ultimately determined by productivity and the terms of trade.

we look for instance at the classification of hotel categories, many of the additional services a hotel has to provide to belong to a higher category require investment in capital.

First of all, let us consider the behavior of the economy when there is a quality standard and no night stay tax. In this context there is no private cost of providing accommodation capacity and therefore firms adjust their K_i/T_i to the legal minimum. Given this, the firm and aggregate revenue functions are respectively:

$$TR_i = \phi\kappa^{\alpha+\gamma-1}K_i^{1-\gamma}G_{Ai}^{\gamma}\left(\frac{G_B}{T}\right)^{\beta}N^{\mu}$$

$$TR = \phi\kappa^{\alpha+\beta+\gamma-1}K^{1-\beta-\gamma}G_A^{\gamma}G_B{}^{\beta}N^{\mu}$$

where κ is the quality standard.

Firms' behavior is determined by the quality standard and:

$$(1-\tau_{TR})(1-\gamma)\frac{TR}{K} = R \qquad (25)$$

The economy behaves according to the aggregate revenue function, (9), (10), (12) and the following equation that results from the combination of (25) and (8):

$$\frac{\dot{C}}{C} = \frac{1}{\theta}\left[(1-\gamma)(1-\tau_{TR})\frac{TR}{K} - \delta - \rho + v(1-\theta)\frac{\dot{N}}{N}\right]$$

The steady state is:

$$N=\left[\frac{1}{\phi}\kappa^{1-\alpha-\beta-\gamma}\left(\frac{\delta+\rho}{1-\gamma}\right)^{1-\beta-\gamma}\left(\frac{1}{1-\tau_{TR}}\right)^{1-\beta-\gamma}\left(\frac{1}{s_A}\right)^{\gamma}\left(\frac{1}{s_B}\right)^{\beta}\right]^{\frac{1}{\mu}}$$

$$T=\frac{\varsigma(\overline{N}-N)}{z}$$

$$K=\kappa T$$

$$TR=\frac{\delta+\rho}{(1-\tau_{TR})(1-\gamma)}K$$

$$C=(1-s_A-s_B)TR-\delta K$$

We would like to compare the steady state welfare levels under both policy regimes. The quality standard as well as the night stay tax are appropriate instruments to reach a given target for long term tourism firms' quality and environmental quality.[20] The key difference lies on the kind of tax system that results from using one or the other policy instrument and particularly on the way the tax burden is shared out between capital income and profits. Specifically, with the night stay tax capital income bears a larger share of the tax burden (profits bear a smaller share) than with the quality standard and therefore in the former policy regime there are lower incentives for capital accumulation. An easy way to understand this difference is to show that the night stay tax acts as an implicit tax on capital. Let us compare expressions (4) and (25), which are the returns to capital when there is a night stay tax and when there is a quality standard, respectively. Notice that in the former policy regime the returns to capital are lower than in the later. In fact, (4) is equal to (25) minus $(1-\tau_{TR})(1-\alpha-\gamma)TR/K$. This later expression is revenues from the night stay tax per unit of capital. Therefore, in comparison with the quality standard, the night stay tax is

[20] It has been shown that both instruments are determinants of the steady state level of environmental quality. Moreover, combining (15) and (16) and imposing the steady state condition it can be shown that the night stay tax determines the long term tourism firm's quality.

equivalent to a tax per unit of capital.[21] It could be argued that in contrast with the quality standard, the night stay tax generates public revenues that could be used to reduce the revenue tax and, in this way, alleviate the tax burden on capital and increase the after tax returns to capital. Even in this case, with a night stay tax capital income pays a larger share of the tax revenues and the returns to capital are lower than when the quality standard is used.[22]

In this model profits can be interpreted as income that accrues to an implicit fixed factor (land or know-how). Therefore, when the night stay tax is used the tax system favors the fixed factor to the detriment of capital while the other way round occurs when we opt for the quality standard. As it is well known, distortions from the tax system are minimized when the tax burden is mainly borne by the fixed factors. This suggests that the quality standard would yield a higher welfare level than the night stay tax. However, this is not always true since the quality standard can give place to a problem of dynamic inefficiency.

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[21] Another way to see this is to show that the quality standard is equivalent to a combination of the night stay tax and a subsidy to capital that keep the public budget balanced. That is, if a subsidy per unit of capital is paid of the amount $su_K=\tau_T T/K$, then $R=(1-\tau_{TR})(1-\gamma)TR/K$, which are the returns to capital when the quality standard is present. Since the revenues from the night stay tax are used in their whole amount to finance the subsidy, the remaining equilibrium conditions coincide with the case of the quality standard. See Bovenberg and Goulder [8] for the same result in a different context.

[22] Regarding the returns to capital, consider a case where there are no lump-sum transfers. With a quality standard it happens that $\tau_{TR}=s_A+s_B$. Returns to capital are therefore $(1-s_A-s_B)(1-\gamma)TR/K$. With a night stay tax that is used to reduce the revenue tax we have that $\tau_{TR}=[s_A+s_B-(1-\alpha-\gamma)]/(\alpha+\gamma)$, expression that comes from the public budget constraint and (5). Therefore, the returns to capital are $[(1-s_A-s_B)/(\alpha+\gamma)]\alpha TR/K$. Given that $1-\alpha-\gamma>0$ it follows that $(1-\gamma)>\alpha/(\alpha+\gamma)$ and therefore the returns to capital are lower with a night stay.

To show this, let us consider that the level of the night stay tax and the quality standard are such that they yield the same steady state environmental quality level. Since residents' welfare only depends on environmental quality and consumption, this allows us to concentrate in the differences in steady state consumption. We also assume that public expenditure relative to tourism revenues is set at its optimal level, that is, $s_A=\gamma$, $s_B=\beta$.[23] For a given level of environmental quality, steady state consumption is:

$$C = (1-\gamma-\beta)\Omega K^{\alpha/(1-\beta-\gamma)} - \delta K \qquad (26)$$

where $\Omega = \left[\phi(\varsigma/z)^{1-\alpha-\beta-\gamma}(\overline{N}-N)^{1-\alpha-\beta-\gamma}\gamma^{\gamma}\beta^{\beta}N^{\mu}\right]^{\frac{1}{(1-\beta-\gamma)}}$

The expression (26) comes from (2'), (17) and the steady state relationship between accommodation capacity and environmental quality, (14). The previous expression yields the usual hump-shape relationship between consumption and capital.

Form (26) the level of capital that maximizes long term consumption can be worked out:

$$K_{GR} = \left(\frac{\alpha\Omega}{\delta}\right)^{(1-\beta-\gamma)/(1-\alpha-\beta-\gamma)}$$

where K_{GR} is the golden rule level of capital.

With a night stay tax steady state capital is:

$$K_1^{\tau_T} = \left[\frac{(1-\gamma-\beta)\alpha\Omega}{\delta+\rho}\right]^{(1-\beta-\gamma)/(1-\alpha-\beta-\gamma)}$$

[23] This assumption simplifies the expressions but the conclusions do not hinge on it.

$$K_2^{\tau_T} = \left[\frac{(1-\gamma-\beta)\alpha\Omega}{(\alpha+\gamma)(\delta+\rho)} \right]^{(1-\beta-\gamma)/(1-\alpha-\beta-\gamma)}$$

where $K_1^{\tau_T}$ and $K_2^{\tau_T}$ stand for the steady state level of capital when the night stay tax revenues are given back in lump-sum fashion and when they are used to reduce the revenue tax, respectively. As it should be expected, in the second case steady state capital is higher since the after tax returns to capital are larger. Moreover, in both cases the level of capital is below the golden rule provided that the revenue tax is positive. Therefore, long term consumption is also higher in the second case.

When the public sector sets a quality standard, capital in the steady state is:

$$K^{\kappa} = \left[\frac{(1-\gamma-\beta)(1-\gamma)\Omega}{\delta+\rho} \right]^{(1-\beta-\gamma)/(1-\alpha-\beta-\gamma)}$$

It is easy to show that in this later case capital reaches a higher level in the steady state than when the night stay tax is used.[24] However, since $\alpha<(1-\gamma)$, with the quality standard the economy could end up with a level of capital above its golden rule level. Therefore, provided that the quality standard do not give place to over accumulation of capital, this instrument yields a higher long term welfare level than the night stay tax. Put it in a different way, a necessary (but not sufficient) condition for the night stay tax to be a better instrument is that under the quality standard regime the economy suffers from dynamic inefficiency.

This analysis raises a final interesting question. In many situations the empirical counterparts to the night stay tax have been motivated as instruments to raise public revenues to finance expenditures aimed

[24] This is always true since $\alpha<\alpha/(\alpha+\gamma)<(1-\gamma)$.

to improve the environmental quality and tourism public infrastructures.[25] This is the case of the "Tax on Stays in Tourism Accommodation Firms"[26] in the Balearic Islands, whose revenues are earmarked to the rehabilitation of tourism areas and the recovery of natural resources. Such earmarking may be explained by political economy reasons (Brett and Keen [9]) or, in the tourism context, as a way to facilitate the acceptance of the tax by the tourism industry and visitors. However, earmarking is not exempt of problems. The most obvious is that there is no reason to assume that the revenues raised would set the public expenditures at its optimal level. For instance, in a case where there are no lump-sum transfers and the revenue tax is high enough, [27] earmarking of the night stay tax to finance public expending would set the public expending relative to tourism revenues above its optimal level. Moreover, a night stay tax may not be the best way to finance additional public expending when this is considered suboptimal. As it has been shown in the previous analysis a better policy form a long-run perspective could be the combination of a quality standard that allows to achieve a given environmental target combined with an increase of the tax revenue aimed to reach an optimal level of public expenditure.

5. CONCLUSIONS

In this paper we have set up what is to our best knowledge the first dynamic general equilibrium model for a tourism economy where the relationship between the tourism activity and the environment plays a key role. The model has been used to analyze some tourism-environmental policy measures. We have shown the conditions for the existence of a double dividend associated with a night stay tax. A crucial

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[25] In a more general setting, Brett and Keen [9] report several cases where environmental taxes have been earmarked, in the sense that the revenue they raise is pre-committed to specific expenditure programs

[26] Parliamentary Act 7/2001, of April 23rd. Other examples are the Transient Room Tax of the Deschutes County, Oregon or the Room Tax of the City of Elko, Nevada.

[27] More specifically, if $\tau_{TR}>(\gamma-(1-\alpha-\beta-\gamma))/(\alpha+\gamma)$.

assumption is the positive effect of the environment on the income generating activities. As it is stressed in the literature (see for example Bovenberg [5]) this is one of the channels through which environmental taxation can yield a double dividend and we believe it to be a very plausible assumption for the tourism industry. The night stay tax improves environmental quality through a reduction in the accommodation capacity and the number of visitors. Regarding tourism revenues and consumption, the fall in the number of visitors has a negative quantitative effect but also a positive quality effect through the improvement of the environment, lower congestion in the use of goods and services provided by the public sector and higher quality of services provided by the tourism firms. Given a linear environmental regeneration function, when initial environmental quality is low enough the positive effect is stronger than the negative effect, giving place to a double dividend. The improvement in the terms of trade plays a key role for this double dividend to take place. Contrary to most of the existing literature on the double dividend, the reduction of distortionary taxes (the revenue tax) is not always the best use of revenues raised by the night stay tax. This is due to the generality of the revenue tax: given that it is levied on the whole tourism revenues it inhibits the provision of accommodation and therefore it plays a role in reducing the environmental impact of tourism.

We have also shown that a quality standard could substitute for the night stay tax in achieving a given environmental target if as a quality standard we understand a given requirement of capital per unit of accommodation capacity. Moreover, from a long term perspective the quality standard could be a better instrument than the night stay tax since the former implies lower taxation on capital. However, under the quality standard the incentives for capital accumulation could be excessive, giving place to dynamic inefficiency.

We hope to have shown that a general equilibrium environmental growth model is a good setting for analyzing issues of interest in economies that heavily rely on the tourism industry. However for giving a more precise answer to the questions we have analyzed it would be desirable to relax some of our simplifying assumptions in future work. Firstly, it would be interesting to consider not so extreme specialization assumptions. Secondly, the policies we have analyzed could trigger a change in the composition of visitors. To account for this, heterogeneity of tourist regarding preferences and environmental impact should be considered. Finally, a distinctive characteristic of tourism is that it allows to “export” goods and services that otherwise would be non-tradable. This has important implications stressed by Copeland [11] and Nowak and Sahli [18] that could be analyzed in extensions of this paper.

APPENDICES

A. Stability of the steady state

In this appendix we discuss the steady state stability conditions under the assumptions that the policy instruments are constant and $s_A=\gamma$, $s_B=\beta$.

Combining (10), (11), (12) (2’) and (5) we arrive at:

$$\dot{C}=\frac{C}{\theta}\left\{\left[\phi\left(\frac{1-\alpha-\gamma}{\tau_T}\right)^{1-\beta-\gamma}(1-\tau_{TR})^{1-\beta-\gamma}\beta^{\beta}\gamma^{\gamma}N^{\mu}\right]^{1/\alpha}\left[\frac{\alpha\tau_T}{1-\alpha-\gamma}-v(1-\theta)z\frac{K}{N}\right]-\delta-\rho+v(1-\theta)\varsigma\frac{\overline{N}-N}{N}\right\}$$

$$\dot{K}=\left\{\left[\phi\left[\frac{(1-\tau_{TR})(1-\alpha-\gamma)}{\tau_T}\right]^{1-\alpha-\beta-\gamma}\beta^{\beta}\gamma^{\gamma}N^{\mu}\right]^{1/\alpha}(1-\beta-\gamma)-\delta\right\}K-C$$

$$\dot{N}=\varsigma(\overline{N}-N)-z\left[\phi\left[\frac{(1-\tau_{TR})(1-\alpha-\gamma)}{\tau_T}\right]^{1-\beta-\gamma}\beta^{\beta}\gamma^{\gamma}N^{\mu}\right]^{1/\alpha}K$$

Linearization around the steady state results in a system whose Jacobian is:

$$B=\begin{pmatrix} b_{11} & b_{12} & b_{13}\\ b_{21} & b_{22} & b_{23}\\ b_{31} & b_{32} & b_{33}\end{pmatrix}$$

$$b_{11}=0 \qquad b_{12}=-\frac{zv(1-\theta)(1-\alpha-\gamma)(\delta+\rho)}{\theta\tau_T\alpha}\frac{C^*}{N^*} \qquad b_{13}=\frac{1}{\theta}\left[\frac{\mu(\delta+\rho)}{\alpha}-v(1-\theta)\varsigma\left(1+\frac{\mu}{\alpha}\frac{\overline{N}-N^*}{N^*}\right)\right]\frac{C^*}{N^*}$$

$b_{21} = -1 \quad b_{22} = \frac{(\delta+\rho)(1-\beta-\gamma)}{\alpha(1-\tau_{TR})} - \delta \qquad b_{23} = \frac{\mu(1-\beta-\gamma)(\delta+\rho)}{\alpha^2(1-\tau_{TR})}\frac{K^*}{N^*}$

$b_{31} = 0 \quad b_{32} = -z\frac{(1-\alpha-\gamma)(\delta+\rho)}{\alpha\tau_T} \qquad b_{33} = -\left[\varsigma + \frac{\mu}{\alpha}\frac{\varsigma(\overline{N}-N^*)}{N^*}\right]$

The determinant of B is:

$$|B| = z\frac{(1-\alpha-\gamma)(\delta+\rho)^2\mu}{\tau_T\alpha^2\theta}\frac{C^*}{N^*} > 0$$

The determinant is positive and therefore there are two possibilities: three positive eigenvalues or one positive and two negative. The characteristic equation is:

$$\lambda^3 - \left\{\Delta - \varsigma - \frac{\mu\varsigma(\overline{N}-N^*)}{\alpha N^*}\right\}\lambda^2 + \left\{\delta\frac{\mu\varsigma(\overline{N}-N^*)}{\alpha N^*} - \varsigma\Delta\right\}\lambda - |B| = 0$$

where $\Delta = \frac{\delta[1-\alpha(1-\tau_{TR})-\beta-\gamma]+\rho(1-\beta-\gamma)}{\alpha(1-\tau_{TR})}$

This equation cannot be solved analytically. However if we set $\theta=\alpha(1-\tau_{TR})/(1-\beta-\gamma)>0$ the eigenvalues are:

$$\lambda_1 = \Delta$$

$$\lambda_2, \lambda_3 = \frac{-\varsigma - \frac{\mu\varsigma(\overline{N}-N^*)}{\alpha N^*} \pm \sqrt{\left[\varsigma + \frac{\mu\varsigma(\overline{N}-N^*)}{\alpha N^*}\right]^2 - 4\frac{\mu\varsigma(\overline{N}-N^*)(\delta+\rho)(1-\beta-\gamma)}{\alpha^2(1-\tau_{TR})N^*}}}{2}$$

The first eigenvalue is positive since $1-\alpha-\beta-\gamma>0$ and $0\leq\tau_{TR}<1$. The other two are negative because:

$$\left[\varsigma + \frac{\mu\varsigma(\overline{N}-N^*)}{\alpha N^*}\right]^2 - 4\frac{\mu\varsigma(\overline{N}-N^*)(\delta+\rho)(1-\beta-\gamma)}{\alpha^2(1-\tau_{TR})N^*} < \left[\varsigma + \frac{\mu\varsigma(\overline{N}-N^*)}{\alpha N^*}\right]^2$$

Therefore, provided that the roots are real, the steady state is a saddle-path. Different values for the intertemporal elasticity of substitution mean horizontal shifts of the characteristic equation. Therefore, this result would hold for a large range of values for θ.

B. Long term effects of a change in the night stay tax

a) Lump-sum transfers are used to keep the public budget balanced

In this case, $\hat{\tau}_{TR} = \hat{G}_A = \hat{G}_B = 0$. Combining (20), (23) and (19) we derive:

$$\hat{T} = -\frac{1-\alpha}{\gamma + \beta + \mu(\bar{N} - N)/N}\hat{\tau}_T \tag{B.1}$$

The combination of (B.1) with (23) yields:

$$\hat{TR} = -\varepsilon \frac{1}{\gamma + \beta + \mu(\bar{N} - N)/N}\hat{\tau}_T \tag{B.2}$$

The expressions (B.1) and (21) imply for the relative change of environmental quality:

$$\hat{N} = \frac{(1-\alpha)(\bar{N} - N)/N}{\gamma + \beta + \mu(\bar{N} - N)/N}\hat{\tau}_T \tag{B.3}$$

From (20) and (B.2) we arrive at the following expression:

$$\hat{K} = -\varepsilon \frac{1}{\gamma + \beta + \mu(\bar{N} - N)/N}\hat{\tau}_T \tag{B.4}$$

Expressions (B.2), (B.4) and (22) imply:

$$\hat{C} = -\varepsilon \frac{(1-\delta s_K)/s_C}{\gamma + \beta + \mu(\bar{N} - N)/N}\hat{\tau}_T \tag{B.5}$$

To obtain the relative change of F first we need to work out the revenue tax level from (3) and (5):

$$\tau_{TR} = \frac{s_A + s_B + s_F - (1-\alpha-\gamma)}{\alpha + \gamma} \tag{B.6}$$

Then, considering (3), (5), (23) and (B.6) we arrive at:

$$dF = (s_A + s_B + s_F)dTR \tag{B.7}$$

Finally, from (B.1), (B.2) and (B.4) we derive relative changes of K/T and the terms of trade.

Notice that these results, apart from (B.7), are independent of the values of s_A, s_B and s_F.

b) Public expenditures are used to keep the public budget balanced

Considering F=0, from (3) and (5) we derive for the revenue tax level:

$$\tau_{TR} = \frac{s_A + s_B - (1-\alpha-\gamma)}{\alpha+\gamma}$$

When $\hat{\tau}_{TR} = \hat{F} = 0$, the previous expression with (5), (23), (24) and the assumption that the relative change of both types of public expenditure is the same yield:

$$\hat{G}_A = \hat{G}_B = \hat{TR} \tag{B.8}$$

Considering (B.8), expressions for the relative change of *T*, *K*, *N*, *TR*, *C*, *K*/*T* and the terms of trade are obtained in a similar way as in the previous case.

When $F \neq 0$, $\hat{G}_A = \hat{G}_B = \hat{F}$ and $\hat{\tau}_{TR} = 0$, we have to take into account that the level of the revenue tax is determined by (B.6). If we combine this expression with (5), (23) and (24) we obtain (B.8). From here we can derive relative changes of *T*, *K*, *N*, *TR*, *C*, *K*/*T* and the terms of trade.

Notice that these results are independent of the values of s_A and s_B.

c) The revenue tax is used to keep the public budget balanced

We obtain these results under the following assumptions: $\hat{F} = \hat{G}_A = \hat{G}_B = 0$, $s_A = \gamma$, $s_B = \beta$ and F=0. Combining (5.20), (23) and (5.19) we derive:

$$\hat{TR} = (\alpha+\varepsilon)\hat{T} + \alpha\hat{\tau}_T \tag{B.9}$$

From (B.9) and (23) we arrive at the following expression:

$$[\varepsilon - (1-\alpha)]\hat{T} - \hat{\tau}_{TR} = (1-\alpha)\hat{\tau}_T \tag{B.10}$$

From (5), (24) and the definition of τ_T^* we obtain:

$$\left[\tau_{TR}(\alpha+\varepsilon)+(1-\alpha-\gamma)(1-\tau_{TR})\right]\hat{T}+(1-\tau_{TR})\hat{\tau}_{TR}=-\left[\alpha\tau_{TR}+(1-\alpha-\gamma)(1-\tau_{TR})\right]\hat{\tau}_{T} \tag{B.11}$$

(B.10) and (B.11) form a system of equations that implies:

$$\hat{T}=-\frac{(1-\alpha-\beta-\gamma)}{\mu(\bar{N}-N)/N}\hat{\tau}_{T} \tag{B.12}$$

$$\hat{\tau}_{TR}=\varepsilon\frac{\beta+\gamma}{\mu(\bar{N}-N)/N}\hat{\tau}_{T} \tag{B.13}$$

where we have considered (3). Under the assumptions $s_A=\gamma$, $s_B=\beta$ and $s_F=0$, the revenue tax is:

$$\tau_{TR}=\frac{\gamma-(1-\alpha-\beta-\gamma)}{\alpha+\gamma}$$

Combining (B.9) and (B.12) we obtain:

$$\hat{TR}=-\varepsilon\frac{1-\beta-\gamma}{\mu(\bar{N}-N)/N}\hat{\tau}_{T} \tag{B.14}$$

The remaining expressions are derived as follows. First, (B.13), (B.14) and (20) yield:

$$\hat{K}=-\varepsilon\frac{1}{\mu(\bar{N}-N)/N}\hat{\tau}_{T} \tag{B.15}$$

Second, from (B.14), (B.15) and (22) we arrive at:

$$\hat{C}=-\varepsilon\frac{1}{\mu(\bar{N}-N)/N}\hat{\tau}_{T} \tag{B.16}$$

Finally, relative change of K/T is the same while if we combine (B.12) and (B.14) we obtain:

$$\hat{TR}-\hat{T}=\hat{P}^{T}=\left[\varepsilon\frac{(\beta+\gamma)}{\mu(\bar{N}-N)/N}+1\right]\hat{\tau}_{T} \tag{B.17}$$

C. Marginal excess burden

Considering the instantaneous utility function for the residents we can derive:

$$0 = dU = \left[CN^{v}\right]^{1-\theta}\left[\hat{C} + v\,\hat{N} + d\lambda/C\right] \qquad \text{(C.1)}$$

Combining (19)-(23) and assuming that $s_A=\gamma$, $s_B=\beta$, we arrive at:

$$\hat{C} = \frac{1}{s_C}\left[\varepsilon\hat{T} + (\alpha - \delta s_K)\hat{K}\right] \qquad \text{(C.2)}$$

The substitution of the definition of ε into (C.2) implies:

$$\hat{C} = \frac{1}{s_C}\left\{\alpha\left(\hat{K} - \hat{T}\right) + \left[(1-\beta-\gamma) - \mu\frac{\overline{N}-N}{N}\right]\hat{T} - \delta s_K\,\hat{K}\right\} \qquad \text{(C.3)}$$

Form (C.3), (20) and (23), we arrive at:

$$\hat{C} = \frac{1}{s_C}\left\{\alpha\left(\hat{K} - \hat{T}\right) + \left[(1-\beta-\gamma) - \mu\frac{\overline{N}-N}{N}\right]\hat{T} - \delta s_K\,\hat{T} - \delta s_K\,\hat{\tau}_T\right\} \qquad \text{(C.4)}$$

Finally, considering that $\hat{\tau}_T = \hat{K} - \hat{T}$ (see table I), $\delta s_K = \delta\frac{\alpha(1-\tau_{IT})}{\delta+\rho}$ (see expression 16) and combining (C.4) with (C.1) and (21) we obtain the expression for the marginal excess burden in section 3.2.

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TABLE I

Long term effects of a marginal change in the night stay tax

		Policy instrument used to keep the public budget balanced		
		F	G_A, G_B	τ_{TR}
1	τ_{TR}	$\hat{\tau}_{TR} = 0$	$\hat{\tau}_{TR} = 0$	$\hat{\tau}_{TR} = \varepsilon \frac{\beta + \gamma}{\mu(\bar{N} - N)/N} \hat{\tau}_T$
2	G_A G_B	$\hat{G}_A = \hat{G}_B = 0$	$\hat{G}_A = \hat{G}_B = \hat{TR}$	$\hat{G}_A = \hat{G}_B = 0$
3	F	$dF = (s_A + s_B + s_F) dTR$	$dF = 0$	$dF = 0$
4	T	$\hat{T} = -\frac{1 - \alpha}{\gamma + \beta + \mu(\bar{N} - N)/N} \hat{\tau}_T$	$\hat{T} = -\frac{(1 - \alpha - \beta - \gamma)}{\mu(\bar{N} - N)/N} \hat{\tau}_T$	$\hat{T} = -\frac{(1 - \alpha - \beta - \gamma)}{\mu(\bar{N} - N)/N} \hat{\tau}_T$
5	N	$\hat{N} = \frac{(1 - \alpha)(\bar{N} - N)/N}{\gamma + \beta + \mu(\bar{N} - N)/N} \hat{\tau}_T$	$\hat{N} = \frac{(1 - \alpha - \beta - \gamma)}{\mu} \hat{\tau}_T$	$\hat{N} = \frac{(1 - \alpha - \beta - \gamma)}{\mu} \hat{\tau}_T$
6	TR	$\hat{TR} = -\varepsilon \frac{1}{\gamma + \beta + \mu(\bar{N} - N)/N} \hat{\tau}_T$	$\hat{TR} = -\varepsilon \frac{1}{\mu(\bar{N} - N)/N} \hat{\tau}_T$	$\hat{TR} = -\varepsilon \frac{1 - \beta - \gamma}{\mu(\bar{N} - N)/N} \hat{\tau}_T$
7	K	$\hat{K} = -\varepsilon \frac{1}{\gamma + \beta + \mu(\bar{N} - N)/N} \hat{\tau}_T$	$\hat{K} = -\varepsilon \frac{1}{\mu(\bar{N} - N)/N} \hat{\tau}_T$	$\hat{K} = -\varepsilon \frac{1}{\mu(\bar{N} - N)/N} \hat{\tau}_T$
8	C	$\hat{C} = -\varepsilon \frac{(1 - \delta s_K)/s_C}{\gamma + \beta + \mu(\bar{N} - N)/N} \hat{\tau}_T$	$\hat{C} = -\varepsilon \frac{1}{\mu(\bar{N} - N)/N} \hat{\tau}_T$	$\hat{C} = -\varepsilon \frac{1}{\mu(\bar{N} - N)/N} \hat{\tau}_T$
9	K/T	$\hat{K} - \hat{T} = \hat{\tau}_T$	$\hat{K} - \hat{T} = \hat{\tau}_T$	$\hat{K} - \hat{T} = \hat{\tau}_T$
10	*Terms of trade*	$\hat{P}^T = \hat{\tau}_T$	$\hat{P}^T = \hat{\tau}_T$	$\hat{P}^T = \left[\varepsilon \frac{(\beta + \gamma)}{\mu(\bar{N} - N)/N} + 1\right] \hat{\tau}_T$

TABLE II

Disaggregation of the effect on accommodation capacity

	Policy instrument used to keep the public budget balanced		
	F	G_A, G_B	τ_{TR}
T	$\hat{T} = -\varepsilon \frac{1}{\gamma + \beta + \mu(\bar{N} - N)/N} \hat{\tau}_T - \hat{\tau}_T$	$\hat{T} = -\varepsilon \frac{1}{\mu(\bar{N} - N)/N} \hat{\tau}_T - \hat{\tau}_T$	$\hat{T} = -\varepsilon \frac{1}{\mu(\bar{N} - N)/N} \hat{\tau}_T - \hat{\tau}_T$