Tourism and environmental quality: a dynamic interaction for the Caribbean

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1.- Introduction:

- The United Nations Environment Programme points out the **interaction between tourism and environmental quality**.
- **Double causality:**
  - Environmental quality $\Rightarrow$ tourism:
    - Raising number of tourists seeking for destinations in environmental hotspots (Christ et al., 2003).
    - Environmental protection projects encourage tourist activities (Font, 2000).
  - Tourism $\Rightarrow$ environmental quality:
    - Negative environmental impact of tourism (e.g., Green et al., 1990; Green and Hunter, 1992; Gossling et al., 2002; Brei et al., 2012).
- This double causality is **very important for the Caribbean**:
  - The rich environmental quality of the Caribbean makes it one of the most appealing destinations for tourism.
  - The environmental deterioration due to tourism negatively affects the growth prospects of these countries.

- Small Island Developing States (SIDS):
  - Tourism and SIDS: one of the few activities for which their location and environments $\Rightarrow$ **strong comparative advantage** (UNWTO, 2012).
  - Some figures (UNWTO, 2012):
    * In the last decade, the number of international tourists visiting SIDS destinations increased by over 12 million to reach 41 million in 2011.
    * The tourism sector accounts for more than half of the exports in at least 12 SIDS.
    * Over one quarter of the Gross Domestic Product (GDP) in at least seven of them.
    * International tourism has increased fastest in the less developed SIDS.
  - **Sustainable tourism**:
    * Double causality between tourism and environmental quality $\Rightarrow$ careful planning and management.
    * Sustainable tourism: important contributor to employment, foreign exchange and **economic growth**.

This paper: we study the **dynamical interaction between tourism and environmental quality**.

- We construct an economic framework to study the dynamical dimension of this interaction.
- Dynamical properties of the problem:
  - Social optimum.
  - Analytical characterization of these properties:
    * Long and short run dynamics: sustainable tourism.
    * Imbalance effects between physical capital and environmental quality: Environmental Kuznets Curve.

2.- The model:

- Technology: $Y(t) = F(E(t), L(t), K(t))$. E.g., $F(\cdot) = AE(t)^{\alpha}L(t)^{\beta}K(t)^{\gamma}$, with $\alpha + \beta + \gamma = 1$
- Economy's budget constraint: $Y(t) = M(t) + I(t) + C(t)$
- Individual's utility function: $u(C(t))$

The model (cont.):

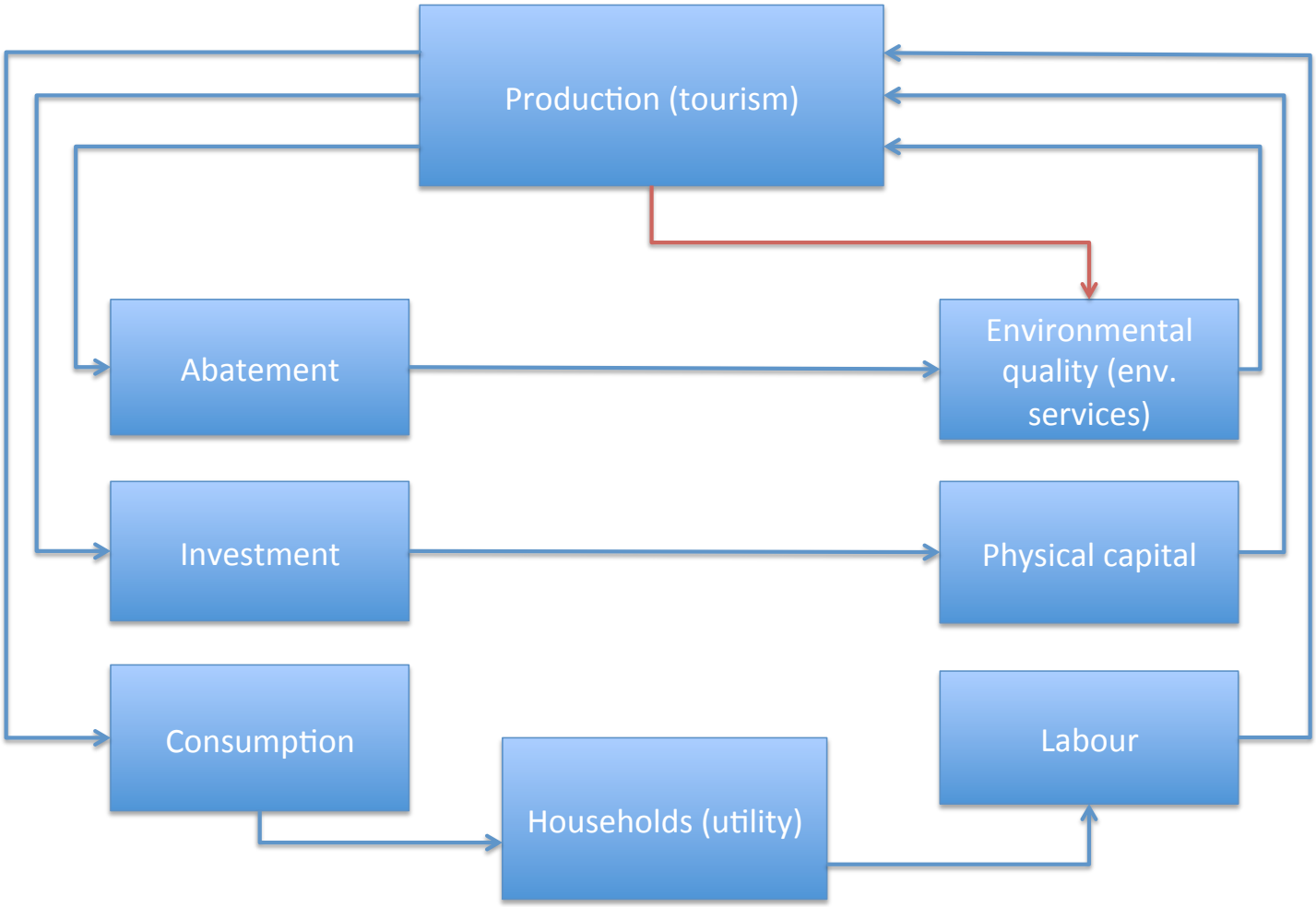
- Law of motion of environmental quality: $\dot{E}(t) = \sigma M(t) - \epsilon E(t) - \zeta Y(t)$
- Law of motion of physical capital: $\dot{K}(t) = I(t) - \delta K(t)$
- Population growth: $L(t) = N(t) = N(0)\exp(nt)$
- **Social optimum problem**: let's define $x(t) \equiv \frac{X(t)}{L(t)}$

$$\max_{\{c,m\}} \int_0^\infty u(c(t))\exp(-(\rho - n)t)dt$$

subject to

$$\begin{cases} \dot{k}(t) = f(e(t), k(t)) - m(t) - c(t) - (\delta + n)k(t), \\ \dot{e}(t) = \sigma m(t) - (\epsilon + n)e(t) - \zeta f(e(t), k(t)), \\ e(0), k(0) \text{ given.} \end{cases}$$

The model (cont.):



3.-Steady-state equilibrium (st/st):

- Definition of st/st: $\dot{c}(t) = \dot{m}(t) = \dot{e}(t) = \dot{k}(t) = 0$
- Given by:

$$(\sigma - \zeta) f_e'^* = \epsilon + \rho \qquad \frac{\sigma - \zeta}{\sigma} f_k'^* = \delta + \rho$$

$$m^* = \frac{1}{\sigma}[\zeta f(e^*, k^*) + (n + \epsilon)e^*] \quad c^* = f(e^*, k^*) - m^* - (\delta + n)k^*$$

- Results:
  - The st/st exists (and is unique) iff **the efficient of abatement is greater than the negative effect of tourism**: $\sigma > \zeta$
  - Environmental quality and physical capital are **strictly positive** in the st/st: $e^*, k^*, m^*, c^* > 0$
  - Comparative statics: if we reduce the negative impact of tourism, ζ, (e.g., **ecotourism instead of regular tourism**) environmental quality increases as well as physical capital and GDP in the long-run.

4.- Dynamics:

- Malgararian's sufficient conditions: FOC are necessary and sufficient.
- Dynamical system: $\{c(t), e(t), k(t)\}$

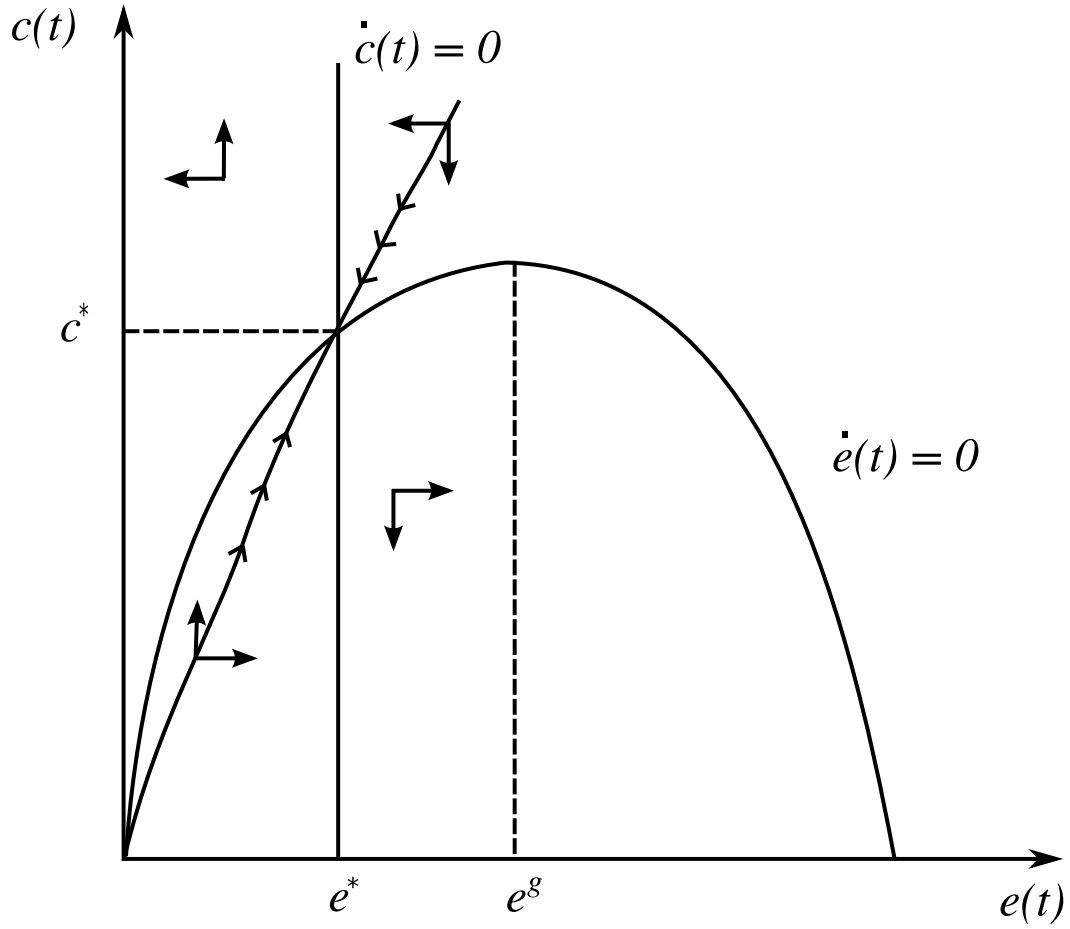
$$\begin{cases} \frac{\dot{c}(t)}{c(t)} = \frac{1}{\varepsilon(c(t))}\left[(\sigma-\zeta)f'_e - (\epsilon+\rho)\right], \\ \dot{e}(t) = (\sigma-\zeta)f(e(t),k(t)) - \sigma\left[c(t) + (\delta+n)k(t) + \dot{k}(t)\right] - (\epsilon+n)e(t)), \\ g(e(t),k(t)) = 0. \end{cases}$$

  - In general $g(\cdot)$ is not linear. However, we can prove: $k(t) = h(e(t))$, where $h(\cdot)$ is unique (and strictly increasing) $\Rightarrow$ we reduce the system to $\{c(t), e(t)\}$.
  - Analytical results: let us assume Cobb-Douglas production function.

Dynamics (cont.):

- Results: stability
  - Local dynamics.
  - **Stability is not possible**.
  - However, it is possible to have **saddle point stability** $\Rightarrow$ unique stable arm:
    - It depends on the characteristics of the economy.
    - **SIDS** $\Rightarrow$ **saddle point stability**:
      - Physical capital depreciates more than the environmental quality: $\delta > \epsilon$,
      - the share of physical capital in the GDP is small: $\gamma < \overline{\gamma}$
      - and the share of environmental quality in the GDP is high: $\alpha > \overline{\alpha}$.
    - **Unique stable arm** $\Rightarrow$ **careful planning and management** (UNWTO, 2012).

- Results: stability (cont.)



Dynamics (cont.):

- Results: imbalance effect
  - Let us recall:

$$\begin{cases} \dot{e}(t) = i_e(t) - (\epsilon + n)e(t), \\ \\ \dot{k}(t) = i_k(t) - (\delta + n)k(t). \end{cases}$$

  - We know that $k(t) = h(e(t))$: e.g, $\frac{k(t)}{e(t)} = \frac{1}{\sigma}\frac{\gamma}{\alpha}$, for $\delta = \epsilon$.
  - $k(0)$ and $e(0)$ are given. But it may happen that $k(0) \neq h(e(0)) \Rightarrow$ **imbalance effect**:
    - $k(0) < h(e(0)) \Rightarrow i_k(t) > 0$ and $i_e(t) \leq 0$ (e.g., SIDS).
    - $k(0) > h(e(0)) \Rightarrow i_k(t) = 0$ and $i_e(t) > 0$.
  - Imbalance between environmental quality and physical capital $\Rightarrow$ **Enviromental Kuznet Curve**.

5.- Conclusions:

- Double causality between tourism and environmental quality.
- We propose a theoretical framework to study the dynamical dimension of this interaction:
  - Tourism can guarantee positive levels of environmental quality and GDP in the long run.
  - But a careful planning and management is required (*saddle point stability*).
  - Possibility of imbalance effects.
- Sustainable tourism seems to be a good strategy for the Caribbean and, in particular, the SIDS.

6.- Extentions:

- Speed of convergence.
- Endogenous growth.
- Empirical quantification of the double causality.