Is Environmental Protection Beneficial for the Environment?

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1. Introduction

- The ***success of the "green growth" discourse*** among policymakers can have two different ***interpretations***:
  - The ***optimistic*** interpretation: a new consensus is emerging on the fact that economic growth and environmental protection are in many respects complementary.
  - The ***pessimistic*** interpretation: in Public Administration rethoric devoting more resources to environmental protection is (wrongly) interpreted as a sufficient condition to ensure higher living standards and a healthier environment.
- In this paper we want ***to illustrate in a very simple theoretical framework*** that the ***compatibility between economic growth and environmental improvement is far from automatic*** and that in the long term it could paradoxically be the case that both the economy and the environment benefit from a lower level of environmental protection.

1. Introduction

- This theoretical result ***does not lend support to the argument that (too much) environmental protection does hurt both the economy and the environment***.
- We just want to point out that ***some forms of environmental protection*** could lead us in the long term to lower levels of consumption and environmental quality and, therefore, lower levels of welfare.

FAE I – EAO I

2. The Benchmark Model

- ***Ramsey-type growth model*** with economic and environmental interaction.
- We will focus on the ***market equilibrium***.
- ***Agents:***
  - ***Households***: receive rents, pay a proportional tax on income, purchase a consumption good and choose how much to save.
  - **Firms:** produce the consumption good with the undesired side-effect of emissions of pollutants.
  - ***Government:*** collects taxes from households and uses them (through the EPA) to finance environmental protection services.

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2. The Benchmark Model

- ***Preferences:***

$$U\left(C_t, E_t\right) = \frac{\left(C_t E_t^{\beta}\right)^{1-\sigma} - 1}{1-\sigma}$$

C_t	Consumption
E_t	Environmental quality
$\sigma > 0$	Inverse of the intertemporal elasticity of substitution
$\beta \geq 0$	"Green preferences" parameter (weight of environmental quality)

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2. The Benchmark Model

- ***Technology:***

  Output is produced by competitive firms (owned by households) according to an ***AK*** technology:

  $$Y_t = aK_t$$

  Y_t Production

  K_t Physical capital

  $a > 0$ Technology scale parameter

  Abatement technology is linear in public expenditure:

  $$A_t = \mu G_t$$

  A_t Abatement

  G_t Public expenditure

  $\mu > 0$ Efficiency of abatement activities

2. The Benchmark Model

- ***Environmental Quality:***

  It is a stock variable whose dynamics depends on:

- **Pollution absortion capacity:**

$$R(E_t) = \theta E_t$$

E_t Environmental quality

$\theta > 0$ Natural rate of absortion

- **Unabated emissions**:

$$X_t = \left(\frac{\upsilon Y_t}{A_t} \right)^{\phi}$$

$\upsilon, \phi > 0$ Measuring environmental efficiency of production activities

Thus, environmental quality ***dynamics:***

$$\dot{E}_t = R(E_t) - X_t = \theta E_t - \left(\frac{\upsilon Y_t}{A_t} \right)^{\phi}$$

2. The Benchmark Model

- ***In general equilibrium,*** maintaining a balanced government budget, that is,

$$G_t = A_t = \tau Y_t$$

where $\tau \in [0,1]$ Income tax rate used to finance abatement,

the ***economic-environmental dynamics*** is totally summarized by the following three equations:

$$\dot{K}_t = (1-\tau) a K_t - C_t$$

$$\frac{\dot{C}_t}{C_t} = \frac{1}{\sigma}\left[(1-\tau)a - \rho\right]$$

$$\dot{E}_t = \theta E_t - \left(\frac{\eta}{\tau}\right)^{\phi}$$

where $\rho \geq 0$ pure rate of time preference

$\eta = \frac{\upsilon}{\mu}$ the relative efficiency of env. services

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2. The Benchmark Model

- ***The role of the tax:*** reallocates resources from physical capital accumulation to environmental protection.

  Thus, the tax is the policy instrument to implement ***softer/tighter environmental policy*** regimes.

- ***BGP*** : since we are in an AK-type framework, there is no transitional dynamics and we focus on the so-called balanced growth path (BGP).

- ***"Win-win" outcome:*** any outcome in which environmental policy can be used to simultaneously promote growth and environmental improvements.

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2. The Benchmark Model

- Condition to allow for endogenous growth and rule out explosive behavior:

$$(1-\sigma)(1-\tau)a < \rho < (1-\tau)a$$

- ***Along the BGP:***

$$\gamma = \frac{a(1-\tau)-\rho}{\sigma}$$

$$\bar{E} = \frac{\eta^{\phi}}{\theta\tau^{\phi}}$$

where $\gamma = \gamma_C = \gamma_K = \gamma_Y$ rate of economic growth

$\bar{E}$ steady state value of environmental quality

and the **welfare** level:

$$W = \frac{\sigma C_0^{1-\sigma} E_0^{\beta(1-\sigma)}}{(1-\sigma)\left[\rho-(1-\sigma)a(1-\tau)\right]} - \frac{1}{\rho(1-\sigma)}$$

2. The Benchmark Model

PROPOSITION 1:

In the market equilibrium of the benchmark model, along the BGP win-win outcomes exist. Softer environmental policy regimes imply both faster economic growth and better environmental quality, increasing welfare.

$$\frac{\partial \gamma}{\partial \tau} = -\frac{a}{\sigma} < 0 \qquad \frac{\partial \overline{E}}{\partial \tau} = -\frac{\phi \eta^{\phi}}{\theta \tau^{\phi+1}} < 0$$

$$\frac{\partial W}{\partial \tau} = -\frac{\sigma C_0^{1-\sigma} E_0^{\beta(1-\sigma)} \left\{ a(1-\tau)\tau + \beta \left[\rho - (1-\sigma) a (1-\tau) \right] \right\}}{\left[\rho - (1-\sigma) a (1-\tau) \right]^2 \tau} < 0$$

FAE I – EAO I

2. The Benchmark Model

- Contrarily to Gradus and Smulders (1993), it is possible to use environmental policy to generate faster growth and environmental improvements at the same time.
- Some other studies also show that win-win outcomes exist (e.g. Smulders, 1999 and Ricci, 2007), but they do so by introducing either productivity effects or other types of capital.
- The main difference with the literature is that we show that win-win outcomes are derived from softer environmental policy regimes.

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3. A Different Specification

- In this section we ***change*** Gradus and Smulders' (1993) ***specification of unabated emissions.***
- As in Economides and Philippopoulos (2008) we assume that environmental dynamics is linear in abatement activities:

$$\dot{E}_t = \theta E_t - \left(\upsilon Y_t\right)^{\phi} + A_t$$

- Similarly to Bartz and Kelly (2008), unabated emissions are represented by:

$$X_t = \upsilon Y_t^{\phi} - A_t = \upsilon\left(1-u_t\right)a^{\phi}K_t^{\phi}$$

where $u_t \in [0,1]$ represents the share of emissions abated by government.

3. A Different Specification

- The government uses ***tax revenue to determine which share of emissions to abate*** taking into account its associated cost:

$$\tau = c(u)$$

- As in Bartz and Kelly (2008), for the sake of simplicity, we specifiy this function as follows:

$$c(u) = 1 - (1-u)^{\varepsilon} \qquad \text{where} \qquad \varepsilon > 1$$

- It is possible to show that *our results hold for any increasing and convex cost function.*

FAE I – EAO I

3. A Different Specification

The ***economic-environmental dynamics*** is totally summarized by the following three equations:

$$\dot{K}_t = (1-u)^{\varepsilon} a K_t - C_t$$

$$\frac{\dot{C}_t}{C_t} = \frac{1}{\sigma}\left[(1-u)^{\varepsilon} a - \rho\right]$$

$$\dot{E}_t = \theta E_t - v a^{\phi} (1-u) K_t^{\phi}$$

FAE I – EAO I

3. A Different Specification

- Condition to allow for endogenous growth and rule out explosive behavior:

$$\frac{(1+\beta\phi)(1-\sigma)(1-u)^{\varepsilon} a}{1+\beta\phi(1-\sigma)} < \rho < (1-u)^{\varepsilon} a$$

- ***Along the BGP:***

$$\gamma = \frac{\gamma_E}{\phi} = \frac{a(1-u)^{\varepsilon} - \rho}{\sigma}$$

$$W = \frac{\sigma C_0^{1-\sigma} E_0^{\beta(1-\sigma)}}{(1-\sigma)\left\{\left[1+\beta\phi(1-\sigma)\right]\rho - (1+\beta\phi)(1-\sigma)(1-u)^{\varepsilon} a\right\}} - \frac{1}{\rho(1-\sigma)}$$

FAE I – EAO I

3. A Different Specification

PROPOSITION 2:

In the market equilibrium of the second model, along the BGP win-win outcomes exist. Softer environmental policy regimes imply both faster economic growth and better environmental quality, increasing welfare.

$$\frac{\partial \gamma}{\partial u} = -\frac{\varepsilon (1-u)^{\varepsilon-1} a}{\sigma} < 0$$

$$\frac{\partial W}{\partial u} = -\frac{\sigma\varepsilon (1+\beta\phi)(1-u)^{\varepsilon-1} a C_0^{1-\sigma} E_0^{\beta(1-\sigma)}}{\left\{[1+\beta\phi(1-\sigma)]\rho - (1+\beta\phi)(1-\sigma)(1-u)^{\varepsilon} a\right\}^2} < 0$$

4. Discussion

- There is a ***wide range of*** activities that could be potentially labelled as ***"environmental protection activities".***
- Two important ***features of the environmental protection activities represented in our models:***
  1. These activities are just meant to **mitigate** anthropogenic emissions
  2. These activities are **"flows" (current expenditures)** as opposed to stocks (investments) that do accumulate over time.
- Thus, we are representing the use of energy, material, maintenance and personnel for producing environmental services such as waste management, waste-water treatment, or reducing and treating air emissions, due to the fact that Nature's capacity to provide ecosystem services has been reduced.

4. Discussion

- ***EU-27*** environmental protection expenditure accounted **for 2.25% of GDP** in 2009 and ***70-80%*** of environmental protection was current expenditure devoted to activities such as water and air quality regulation and waste management (Eurostat, 2012).
- In response to the (financial) crisis, many governments have devised ***"green recovery plans"*** as a way of reviving demand, creating jobs and accelerating the transition to a more sustainable economy.
- However, there is ***considerable diversity*** in the plans that have been issued to date.
- **Some measures lack the long term perspective that corresponds to green policies** and focus more on recovery from the crisis rather than changing production and consumption patterns.

4. Discussion

	Public environmental protection expenditure (% GDP)	GDP growth rate (%)	Adjusted savings: particulate emission damage (% of GNI)	Adjusted savings: net forest depletion (% of GNI)
Norway	0,57	2,7	0,26	0,00
Germany	0,49	3,3	0,36	0,01
Sweden	0,40	3,3	0,21	0,00
UK	1,00	3,4	0,26	0,00
Finland	0,33	5,3	0,09	0,00
Czech Republic	1,15	5,7	0,78	0,07
Poland	0,62	6,8	0,61	0,20
Slovak Republic	0,72	10,5	0,47	0,54

Date: 2006
Source: Eurostat, OECD and World Bank

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