Protecting the environment: On the interplay between voluntary contributions and public policy

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Motivation

- People do care about the environment
- Their engagement in environmental protection is growing
- Recent OECD household survey reveals:
  - 14% drive a fully electric car (urban areas)
  - 19% use electricity generated from renewables
  - 23% save energy for environmental reasons
- Yet, policymakers often face low public support for env. measures

This Paper

- A rationale for these seemingly paradoxical observations
- We model environmental quality as a public good
- Provision is affected by public policy + private contributions
- Public policy is chosen on behalf of all currently living individuals

Environmental Policy and Private Contributions

- Static partial-equilibrium approach
  - Nyborg et al. (2006), Perino (2015), Daube & Ulph (2016), Wichman (2016), Ambec & De Donder (2022)
- Dynamic general-equilibrium approach
  - Exogenous public policy
    - Ballet et al. (2007), Dam & Heijdra (2011), Fodha & Seegmuller (2012), Constant & Davin (2018)
  - Endogenous public policy
    - Bezin (2015), Heijdra & Heijnen (2021)

Our contribution: endogenously determined pollution taxes in an overlapping-generations model with private contributions

Overview of the Results

- Private env. abatement increases public opposition to pollution taxes
- This can reduce environmental quality in the long run
- If subsidized, private abatement can increase the preferred tax rate

Model Setup

- Discrete time, $t \in \{0, 1, \dots\}$
- A unit mass of identical individuals is born every t
- Individuals live for 2 periods, young and old
- When young, an individual born at t faces

$$(1 + \tau_t)c_t^y + m_t + s_t = w_t$$

  - m_t: her environmental expenditures
- When old, she consumes the proceed of her savings,

$$(1 + \tau_{t+1})c_{t+1}^o = R_{t+1}s_t$$

Preferences

- Preferences of individuals are represented by

$$u(c_t^y, E_t) + \theta v(m_t) + \beta u(c_{t+1}^o, E_{t+1})$$

  - θ: 'warm glow' intensity (Andreoni (1990))
  - E_t: environmental quality in period t
- Environmental quality is a public good
- For given (E_t, E_{t+1}), individuals behave such that

$$u_1'(c_t^y, E_t) = \theta(1+\tau_t)v'(m_t)$$

$$(1+\tau_{t+1})u_1'(c_t^y, E_t) = \beta R_{t+1}(1+\tau_t)u_1'(c_{t+1}^o, E_{t+1})$$

Environmental Quality

- As in John & Pecchenino (1994) and John et al. (1995), consumption degrades the environment
  - e.g., via electricity/water use in homes, driving a personal car, household solid waste generation
- Environmental quality evolves according to

$$E_{t+1} = bE_t - \rho(c_t^y + c_t^o) + \varepsilon m_t + \gamma g_t$$

  - $g_t \geq 0$: government expenditures
- For now, we do not assume any relationship btw ε and γ

Firms

- Standard neoclassical production function:

$$Y_t = F(K_t, L_t)$$

- Normalization + inelastic labor supply $\Rightarrow L_t = 1$
- Capital depreciates fully in one period
- Perfectly competitive markets:

$$R_t = f'(k_t), \ \ w_t = f(k_t) - k_t f'(k_t)$$

- In equilibrium, the capital stock is equal to savings,

$$k_{t+1} = s_t$$

Environmental Policy

- One-period lived government that chooses (τ_t, g_t)
- It cares only about individuals alive in period t:

$$\kappa u(c_t^o, E_t) + u(c_t^y, E_t) + \theta v(m_t) + \beta u(c_{t+1}^o, E_{t+1})$$

- Policy (τ_t, g_t) maximizes this objective subject to all the above conditions
- Government budget is balanced,

$$g_t = \tau_t(c_t^y + c_t^o) \equiv \tau_t c_t$$

- Government correctly foresees τ_{t+1} but does not try to influence it

Solving the Model

- In what follows, we restrict attention to $g_t > 0$ and

$$u(c, E) = \ln c + \lambda \ln E, \;\; v(m) = \ln m, \;\; f(k) = k^\alpha$$

  - λ: degree of (public) environmental concerns

- For the sake of brevity, let us denote

$$s(\theta) \equiv \frac{\beta(1-\alpha)}{1+\theta+\beta}$$

- We shall see that $s(\theta)$ characterizes the saving rate of the economy

Equilibrium Policy

Proposition 1

The equilibrium environmental policy (τ_t, g_t) *is given by*

$$\tau_t = \frac{1}{1+\kappa} \frac{(1+\kappa+\beta\lambda)(\rho+\gamma)[s(\theta)+\beta\alpha]k_t^\alpha}{\beta b E_t + [(\varepsilon\theta+\gamma)s(\theta)+\gamma\beta\alpha]k_t^\alpha} - 1,$$

$$g_t = \left[1 - s(\theta) - \frac{\theta s(\theta)}{\beta} - \frac{s(\theta)+\beta\alpha}{\beta(1+\tau_t)}\right] k_t^\alpha .$$

Both τ_t and g_t are high when environmental quality E_t is low and/or national income k_t^α is high

Dynamics and the Steady State

Equilibrium dynamics of the economy is described by

$$k_{t+1} = s(\theta)k_t^{\alpha}$$

$$E_{t+1} = \frac{\lambda\{\beta b E_t + [(\varepsilon\theta + \gamma)s(\theta) + \gamma\beta\alpha]k_t^{\alpha}\}}{1 + \kappa + \beta\lambda}$$

Proposition 2

(a) *The capital stock k_t and the environmental quality E_t converge to their steady-state values k^* and E^*, respectively. These steady-state values are given by*

$$k^* = [s(\theta)]^{\frac{1}{1-\alpha}} \quad \text{and} \quad E^* = \frac{\lambda\{(\varepsilon\theta + \gamma)s(\theta) + \gamma\beta\alpha\}[s(\theta)]^{\frac{\alpha}{1-\alpha}}}{1 + \kappa + \beta\lambda(1 - b)}.$$

Individual Behavior in the Steady State

Proposition 2 (cont'd)

(b) *In the steady state, the equilibrium values of private environmental expenditures m_t and total consumption c_t are given, respectively, by*

$$m^* = \frac{\theta}{\beta}[s(\theta)]^{\frac{1}{1-\alpha}} \quad \text{and} \quad c^* = \frac{(1+\kappa)\{(\varepsilon\theta+\gamma)s(\theta)+\gamma\beta\alpha\}[s(\theta)]^{\frac{\alpha}{1-\alpha}}}{\beta(\rho+\gamma)[1+\kappa+\beta\lambda(1-b)]}.$$

The 1st equation reflects an individual trade-off, whereas the 2nd one reflects a collective trade-off

Comparative Statics

- Parameters of interest are λ and θ
- Effects of environmental concerns, λ:

$$\frac{\partial k^*}{\partial \lambda} = \frac{\partial m^*}{\partial \lambda} = 0; \ \frac{\partial E^*}{\partial \lambda} > 0; \ \frac{\partial c^*}{\partial \lambda} < 0$$

- Effects of environmental 'warm glow', θ:

$$\frac{\partial k^*}{\partial \theta} < 0; \ \frac{\partial m^*}{\partial \theta} > 0 \ \Leftrightarrow \ \theta < (1+\beta)(1-\alpha)/\alpha$$

$$\frac{\partial E^*}{\partial \theta} < 0 \ \Leftrightarrow \ \frac{\partial c^*}{\partial \theta} < 0 \ \text{ if } \ \frac{\gamma}{\varepsilon} > \frac{(1-\alpha)^2(1+\beta)}{1-\alpha+\alpha^2(1+\beta)}$$

Comparative Statics (cont'd)

- Denote by (τ^*, g^*) the steady-state environmental policy
- Effects of environmental concerns, λ:

$$\frac{\partial \tau^*}{\partial \lambda} > 0; \ \frac{\partial g^*}{\partial \lambda} > 0$$

- Effects of environmental 'warm glow', θ:

$$\frac{\partial \tau^*}{\partial \theta} < 0; \ \frac{\partial g^*}{\partial \theta} < 0$$

- Thus, pro-environmental individual behavior reduces the support for public policy

Model with Environmental Subsidies

- When young, an individual born at t faces

$$(1+\tau_t)c_t^y + (1-\rho_t)m_t + s_t = w_t$$

- One-period lived government chooses (τ_t, ρ_t, g_t)
- Government budget constraint is modified to

$$g_t + \rho_t m_t = \tau_t(c_t^y + c_t^o)$$

Comparative Statics Results

- Similar results, with the following new insights
- Effects of environmental concerns, λ:

$$\frac{\partial m^*}{\partial \lambda} < 0; \;\; \frac{\partial \rho^*}{\partial \lambda} < 0$$

- Higher public concerns imply lower private contributions
- Effects of environmental 'warm glow', θ:

$$\frac{\partial \rho^*}{\partial \theta} > 0; \;\; \frac{\partial \tau^*}{\partial \theta} \lesseqgtr 0 \;\; \Leftrightarrow \;\; \theta \lesseqgtr \bar{\theta},$$

where

$$\bar{\theta} > 0 \;\; \Leftrightarrow \;\; \kappa + \beta \lambda b > \frac{\alpha(1+\beta)}{1-\alpha}$$

Possible Further Work

- Some individuals do not derive ‘warm glow’
- Individuals follow social norms when choosing m_t
- Polluting production
- Complementary effect of m_t and g_t on E_{t+1}
- Government is sophisticated/long-lived

Conclusion

- We study the interaction btw pro-env. behavior and public env. policy
- Public policy is endogenously determined
- Pro-env. behavior reduces public support for pollution taxes
  - $\Rightarrow$ This can reduce environmental quality in the long run
- If subsidized, private abatement can increase the preferred tax rate