Optimal fiscal policy when tastes are inherited and environmental quality matters

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Introduction

- Short-lived individuals fail to internalize long term impact of present decisions on future environmental degradation.
- Intergenerational aspect of the problem justifies the use of the OLG model (see, John and Pecchenino, 1994; Ono, 1996; Bovenberg and Heijdra, 1998).
- Introduction of additional intergenerational externality under the form of aspirations in consumption and environmental quality.
- Aspirations are inherited from previous generation and used as a reference to evaluate utility (De la Croix, 1996; De la Croix and Michel, 1999; Alonso-Carrera et al. 2007).

Introduction

- Aspirations have been disconnected from environmental concerns (exceptions: Schumacher and Zou, 2008; Aronsson and Johansson-Stenman, 2014).
- Presence of aspirations highlights the importance of relative well-being. Utility does not only depend on levels but also on some reference point (Clark and Oswald, 1996; Ferrer-i-Carbonell, 2005).
- Large evidence in favor of intergenerational transfer of tastes between parents and children (Becker, 1992; Waldkirch et al., 2004; Senik, 2009).

Introduction

- Our paper can be related to works linking habits and status effects to environmental degradation (Wendner, 2003, 2005; Brekke and Howarth, 2003; Howarth, 2006).
- OLG model with identical agents (focus on efficiency). Agents live for two periods and work only in the first. Population is constant.
- Production takes place with constant returns to scale technology using capital and labor.
- Arbitrary taxes are used to finance given stream of public expenditures.

The model

- Few studies have focused on second-best policies with relative well-being and environment.
- Lifetime utility: $U(c_t, a_t, d_{t+1}, n_t, E_t, E_{t+1})$.
- Utility exhibits consumption aspirations in young age $a_t = c_{t-1}$ and environmental aspirations in old age E_t.
- Utility separable across periods of life and between consumption, labor and environmental quality.
- $U_{c_t}, U_{d_{t+1}}, U_{E_{t+1}} > 0$, $U_{a_t}, U_{n_t}, U_{E_t} < 0$ and $U_{c_t a_t}, U_{E_{t+1} E_t} > 0$.

The model

- When young, labor income split between consumption, maintenance investment and savings:

$$(1+\tau_t^c)c_t + (1+\tau_t^m)m_t + s_t = (1-\tau_t^w)w_t n_t.$$

- When old, capital income used for consumption:

$$(1+\tau_{t+1}^c)d_{t+1} = [1 + r_{t+1}(1-\tau_{t+1}^r)]s_t,$$

where τ^i are the different tax rates.

- Output produced by representative firm with a constant returns to scale production function using capital and labor: $F(k_t, n_t)$.

The model

- Equality between prices and marginal productivities:

$$\begin{aligned} w_t &= F_{n_t}(k_t, n_t), \\ r_t + \delta &= F_{k_t}(k_t, n_t). \end{aligned}$$

where δ is the depreciation rate of the capital stock.

- Market clearing implies that savings equal the future capital stock:

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

The model

- Evolution of environmental quality:

$$E_{t+1} = E_t + b(\overline{E} - E_t) - \kappa_c(c_t + d_t) + \kappa_m m_t.$$

where b natural regeneration rate, $\overline{E}$ natural level of environmental quality, κ_c impact of pollution, κ_m impact of maintenance investment.

- When solving the optimization problem, the agent takes into account the impact of young age consumption and maintenance investment on environmental quality.

- Impact of old age consumption on environmental quality not taken into account. Intergenerational externality.

The model

- The government collects taxes in order to finance a given level of public expenditures G_t:

$$G_t = \tau_t^c(c_t + d_t) + \tau_t^m m_t + \tau_t^w w_t n_t + \tau_t^r r_t k_t.$$

- By solving optimization problem of a representative generation we obtain following equilibrium conditions:

- Intertemporal allocation of consumption:

$$\frac{U_{c_t}}{U_{d_{t+1}}} = \frac{[1 + r_{t+1}(1 - \tau_{t+1}^r)][\kappa_m(1 + \tau_t^c) + \kappa_c(1 + \tau_t^m)]}{\kappa_m(1 + \tau_{t+1}^c)}.$$

The model

- Intratemporal allocation between young age consumption and leisure:

$$-\frac{U_{c_t}}{U_{n_t}} = \frac{\kappa_m(1+\tau_t^c) + \kappa_c(1+\tau_t^m)}{\kappa_m(1-\tau_t^w)w_t}.$$

- Intratemporal allocation between young age consumption and maintenance investment:

$$\frac{U_{c_t}}{U_{m_t}} = \frac{\kappa_m(1+\tau_t^c) + \kappa_c(1+\tau_t^m)}{\kappa_m(1+\tau_t^m)}.$$

- In competitive equilibrium, policies are arbitrary. We will now study optimal fiscal policies taking the behavior of agents as given.

Optimal fiscal policy

- The government has access to a commitment technology preventing revision of the optimal plan.
- Problem solved following the primal approach (Lucas and Stockey, 1983; Chari and Kehoe, 1999).
- Planner chooses directly the optimal allocation (instead of tax rates) from a restricted set of allocations.
- Implementable allocation should satisfy the intertemporal budget constraint as well as the first-order conditions of the competitive equilibrium.

Optimal fiscal policy

- Computation of the implementability constraint (unique for each generation):

$$\lambda_t \left[(1+\tau_t^c)c_t + (1+\tau_t^m)m_t - (1-\tau_t^w)w_t n_t + \frac{(1+\tau_{t+1}^c)d_{t+1}}{1+r_{t+1}(1-\tau_{t+1}^r)} \right] = 0.$$

- Use FOC to substitute for taxes and prices and obtain the implementability constraint for generation t:

$$U_{c_t}c_t + U_{E_{t+1}}(\kappa_m m_t - \kappa_c c_t) + U_{d_{t+1}}d_{t+1} + U_{n_t}n_t = 0.$$

Optimal fiscal policy

- Objective of the planner is to maximize the discounted sum of utilities subject to the implementability constraints, the feasibility constraint and the evolution of environmental quality.
- For initial old generation, τ_0^r is fixed in order to avoid lump-sum taxation. d_0 fixed as well.
- Objective function for generation t given by:

$$\begin{aligned} W^t &= U^t \\ &+\mu_t \left[U_{c_t} c_t + U_{E_{t+1}} (\kappa_m m_t - \kappa_c c_t) + U_{d_{t+1}} d_{t+1} + U_{n_t} n_t \right]. \end{aligned}$$

Optimal fiscal policy

- Planner solves the following problem:

$$\max \sum_{t=0}^{\infty} \zeta^t W^t,$$

subject to:

$$c_t + d_t + m_t + k_{t+1} + G_t - F(k_t, n_t) - (1-\delta)k_t = 0,$$
$$E_{t+1} - E_t - b(\overline{E} - E_t) + \kappa_c(c_t + d_t) - \kappa_m m_t = 0,$$

given initial conditions $\{k_0, d_0, E_0, c_{-1}\}$.

- ζ is the social discount factor. $-\zeta^t \mu_t^1$ and $\zeta^t \mu_t^2$ are the multipliers of both constraints.

Optimal fiscal policy

- At the optimum, capital taxes must satisfy the following condition:

$$\tau^r_{t+1} \quad = \quad \frac{1}{F_{k_{t+1}} - \delta}\left[1 + F_{k_{t+1}} - \delta - \frac{U^*_{c_t}}{U^*_{d_{t+1}} h(.)}\right],$$

where $h(.) = [\kappa_m(1+\tau^c_t) + \kappa_c(1+\tau^m_t)]/\kappa_m(1+\tau^c_{t+1})$.

- $\tau^r_{t+1} = 0$ if $h(.) = \overline{h} > 1$. $\tau^r_{t+1} < (>) 0$ if $h(.) < (>) \overline{h}$.

- Maintenance subsidies and increasing consumption taxes $(\tau^c_t < \tau^c_{t+1})$ associated to larger capital subsidies.

Optimal fiscal policy

- At the optimum, capital taxes must also satisfy:

$$\tau^r_{t+1} = \frac{1}{F_{k_{t+1}} - \delta}\left[1 + F_{k_{t+1}} - \delta - \frac{U^*_{n_t}}{U^*_{d_{t+1}} F_{n_t}} p(.)\right],$$

  where $p(.) = 1 + \tau^c_{t+1}/1 - \tau^w_t$.

- $\tau^r_{t+1} = 0$ if $p(.) = \overline{p} > 1$. $\tau^r_{t+1} < (>) 0$ if $p(.) > (<) \overline{p}$.

- Capital subsidies only possible if income and consumption taxes are sufficiently large.

Optimal fiscal policy

- Decentralization of optimal allocation also requires

$$\frac{1+\tau_t^c}{1+\tau_t^m} > 1 - \frac{\kappa_c}{\kappa_m}$$

- Policy implies an increase in savings since aspirations induce overconsumption in young age.
- In standard OLG model, intervention on capital justified when agents work in all periods. Here result driven by aspirations.
- Results related to the inability of the planner to impose age-dependent taxes.

Quantitative illustration

- Logarithmic utility function:

$$U = \theta \ln(c_t - \rho_c a_t) + \epsilon \ln(1 - n_t) + \beta\theta \ln(d_{t+1}) + \beta\eta \ln(E_{t+1} - \rho_e E_t).$$

- Cobb-Douglas production function:

$$F(k_t, n_t) = A k_t^{\alpha} n_t^{1-\alpha}.$$

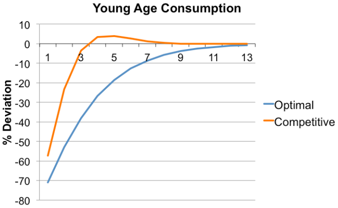
- Values for the parameters: $\theta = 1$, $\epsilon = 2$, $\beta = 0.3$, $\eta = 0.9$, $\rho_c = \rho_e = 0.65$, $\alpha = 0.33$, $\delta = 1$, $\zeta = 0.99$, $\kappa_c = 0.1$, $\kappa_m = 0.2$, $b = 0.2$.

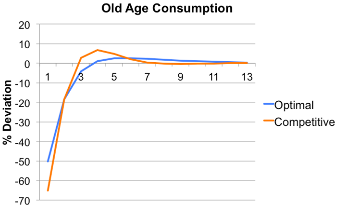
- Fixed public spending/output ratio $= g = 0.23$.

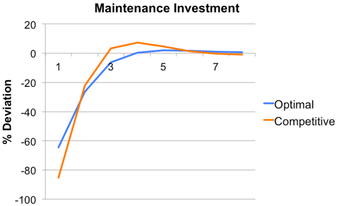
Quantitative illustration

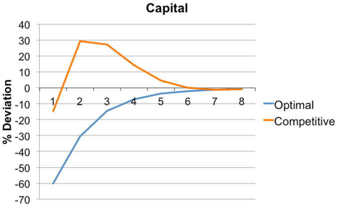
- In competitive equilibrium fixed tax rates: $\tau^c = 0.17$, $\tau^r = 0.33$, $\tau^w = 0.41$, $\tau^m = 0$.
- In optimal case, computation of optimal tax rates. Need to fix one of the tax rates and we choose consumption taxes.
- Initial conditions for state-variables k_0, E_0, a_0 are set at 10% of the steady-state values.
- Competitive equilibrium displays overshooting behavior. Two roles for optimal policy: internalize externalities and stabilization device.

Quantitative illustration

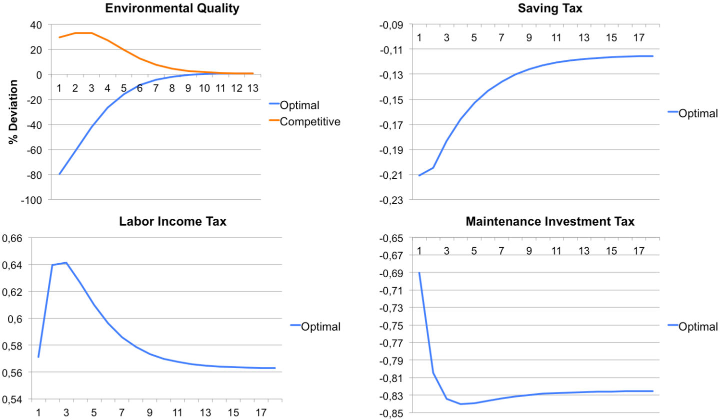








Quantitative illustration



Conclusion

- Aspirations in consumption imply that capital must be subsidized in some way.
- Larger maintenance subsidies and increasing consumption taxes are associated to smaller capital taxes.
- Public spending must be financed mostly by income and consumption taxes.
- Here focus on representative generation. Next focus on intragenerational heterogeneity.