SELF-PROTECTION CHOICES, CONSUMPTION PATTERNS AND ECONOMIC GROWTH

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SELF-PROTECTION CHOICES:

- DEFINITION: choices to protect against environmental deterioration
- EXAMPLES:
  - mineral water
  - holidays in some tropical paradise
  - double windows etc….

Agents' welfare depends on three goods:

- Leisure (1-l)
- a free access (renewable) environmental good (E)
- a private good which can be consumed as a substitute for the environmental good (c_2) or to satisfy needs different from those satisfied by the environmental good (c_1)

Consumption and production of the private good depletes the renewable natural resource.

To counterbalance such depletion, agents may increase their labor supply in order to produce and consume higher quantities of the private good. The consequent growth of production and consumption generates a further depletion of the environmental good which leads to a further increase of production and consumption of the private good an so on.

This substitution mechanism may be an engine of economic growth. In this context, we show that economic growth may worsen individuals' welfare.

RELATED LITERATURE

- Antoci (1996) “Negative externalities and growth of the activity level”, Quaderno n. 9308 del Progetto Nazionale MURST "Dinamiche non lineari e applicazioni alle scienze economiche e sociali", Università di Firenze.

- Antoci and Bartolini (1997) “Externalities and growth in an evolutionary game”, Discussion papers n. 9, Dipartimento di Economia, Università di Trento

- Antoci, Sacco and Vanin (1999) “Social capital dynamics and social poverty traps”, preprint, Università di Bologna.

- Antoci and Borghesi (2000) “Growth led by negative externalities in a North-South model”, mimeo.

DYNAMICS WITHOUT CAPITAL ACCUMULATION

Production function: $Y = \alpha l$ with $\alpha > 0$

Since Y is not storable: $Y = c_1 + c_2$

Utility function:

$$U(c_1, c_2, l, E) = \ln(c_1) + a\ln(E + bc_2) + d\ln(1 - l) \qquad (1)$$

where a,b,d > 0

Dynamics of *E*:

$$\dot{E} = \beta E(\overline{E} - E) - \gamma\alpha\bar{l}E \qquad \text{with } \beta, \gamma, \overline{E} > 0 \qquad (2)$$

$\bar{l}$: average labor employed in the economy

$\overline{E}$: value that E should approach if there were no production and consumption of the private good in the economy

Behavioral assumption: the representative agent takes $\bar{l}$ as exogenously given

$$MAX \int_0^{\infty} [\ln(c_1) + a\ln(E + bc_2) + d\ln(1-l)]e^{-rt}dt$$

$$s.t.\ \dot{E} = \beta E(\bar{E} - E) - \gamma\alpha\bar{l}E$$

optimality conditions:

$$\frac{\partial U}{\partial l} = \frac{\alpha}{\alpha l - c_2} - \frac{d}{1-l} = 0 \qquad (3)$$

$$\frac{\partial U}{\partial c_2} = -\frac{1}{\alpha l - c_2} + \frac{ab}{E + bc_2} \le 0, c_2 \ge 0, c_2 \frac{\partial U}{\partial c_2} = 0 \qquad (4)$$

NB: c_2, l are chosen without taking the "price" of E into account

$$\tilde{c}_2(E) \equiv \begin{cases} 0 & \text{if } E \ge \dfrac{ab\alpha}{1+d} \\ \dfrac{a\alpha}{1+a+d} - \dfrac{1+d}{b(1+a+d)}E & \text{if } E < \dfrac{ab\alpha}{1+d} \end{cases}$$

$$\tilde{l}(E) \equiv \begin{cases} \tilde{l}_1(E) = \dfrac{1}{1+d} & \text{if } E \ge \dfrac{ab\alpha}{1+d} \\ \tilde{l}_2(E) = \dfrac{1+a}{1+a+d} - \dfrac{d}{\alpha b(1+a+d)}E & \text{if } E < \dfrac{ab\alpha}{1+d} \end{cases}$$

c_2 and l increase if E falls beyond $\dfrac{ab\alpha}{1+d}$.

Along the trajectories where the value of E decreases, we have "economic growth"

THE ECONOMY WITH A POLICY MAKER

If the representative agent takes the negative impact of his choices on *E* into account:

$$\frac{\partial H}{\partial l} = \frac{\alpha}{\alpha l - c_2} - \frac{d}{1-l} - \alpha\gamma E\lambda = 0 \qquad (5)$$

$$\frac{\partial H}{\partial c_2} = -\frac{1}{\alpha l - c_2} + \frac{ab}{E + bc_2} \leq 0, c_2 \geq 0, c_2 \frac{\partial H}{\partial l} = 0 \qquad (6)$$

The production level is lower than without policy maker

From the dynamics of E and λ we have that if the discount factor r is high enough, then there exist two saddle points, one with $E = 0$ and the other with $E > 0$, such that the former is Pareto dominated by the latter. This means that even in an economy where negative externalities are internalized, a Pareto dominated fixed point may be selected if future generations' welfare is not sufficiently taken into account.

THE MODEL WITH CAPITAL ACCUMULATION (WORK IN PROGRESS!)

Maximization problem:

$$\max \int_0^{\infty} [\ln c_1 + a \ln(E + bc_2) + d \ln(1-l)] e^{-rt} dt$$

sub. to:

$$\dot{K} = l^{\sigma} K^{1-\sigma} A - c_1 - c_2 \qquad (7)$$

$$\dot{E} = \beta E(\bar{E} - E) - \gamma(\bar{c}_1 + \bar{c}_2)E \qquad (8)$$

where $1 > \sigma > 0, \delta > 0, \varepsilon > 0, A = l^{\delta} K^{\varepsilon}$ is a (positive) externality

The representative agent considers A, $\bar{c}_1$ and $\bar{c}_2$ as exogenously determined.

Preliminary result from numerical simulations: the fixed point E = 0 may Pareto dominate E > 0

CONCLUSIONS

Innovative feature of the model: economic growth may be driven by negative externalities. In our approach, environmental deterioration may induce agents to work harder to substitute previously free environmental goods with produced substitute goods. This further depletes the environment which increases in turn production and consumption of substitute goods.

In a very simple model without capital accumulation economic growth may lead to a Pareto-dominated solution, even if negative externalities are internalized (case with a policy maker). However, this may not be the case when capital accumulation taken into account