

On "Dynamics of natural capital in neoclassical growth model", by Marta Kornafel and Ivan Telega,
Cracow University of Economics

Discussant: Alessandro Rossi

European Commission, Joint Research Centre

*DG ECFIN-OGWG workshop on
"Natural capital measurement and modelling", 30 November 2023*

(C) European Union, 2023



Focus of the paper

The paper focuses on a closed economy growth models where output follows from a Cobb Douglas production function.

Natural capital is not a principal factor of the production function but is modelled in the form of an aggregated renewable resource whose dynamics depends on investment.

Main objectives are:

- identify conditions for the existence of stable equilibria for manufactured and natural capital;
- identify conditions for sustainable economic growth with increasing consumption of materials.



- The model
- Main findings
- Comments

The model

- Output: $Y = A^{1-\alpha}K^\alpha$, $Y = I + V + C$

- Dynamics: $\dot{A} = g_A A$

$$\dot{K} = I - \delta K$$

$$\dot{N} = rN\left(\frac{N}{CT} - 1\right)\left(1 - \frac{N}{CC}\right) - P + V^\omega$$

$P = \gamma_0 A^{-a} Y^n$, $\gamma = \gamma_0 A^{-a} Y^{n-1}$ is the material intensity of the economy (Rodrigues et al, 2005).

- Parameters: r natural capital regeneration rate, CC max capacity of the environment, CT critical threshold, $n \in (0, 1)$ and $a > 0$, elasticity of material intensity wrt production and technology, empirically $n > a$, $\omega \in (0, 1)$ man-made restoration of N .



Main findings: stylized model

Assume $V = 0$, $A = 1$ and let $s = I/Y$:

- Equilibrium:
$$K^* = (s/\delta)^{\frac{1}{1-\alpha}} > 0$$
$$N^* > 0$$
- Satisfied if $\Delta(r, CT, CC, a, n, s, \alpha, \delta) < 0$:
 - When CC or r diverge there are two positive stationary points for man-made and natural capital;
 - If $CT \simeq CC$ or $r \rightarrow 0$ no positive stationary point exists: natural capital is exploited;
- $CC \rightarrow 0$ standard Solow growth model, $CT \rightarrow 0$ the model in Rodrigues et al. (2005).



Main findings: the role of technology and investment in natural capital

- If $g_A = g(\dot{K}/K)$ then:

- Under plausible assumptions on $g(\cdot)$, sustainable growth is possible with constant growth rates for Y , A and K ;

- Let $s = I/Y > 0$ and $\nu = V/Y > 0$, with $s + \nu < 1$:

- Investment in natural capital (ν) may help in obtaining an equilibrium.
- The bigger the material intensity (γ_0), the less likely is to find a rate of investment in natural capital (ν) which allows for an equilibrium.



- Inserting natural capital into growth models is certainly of great interest.
- Looking at the behaviour of the model for plausible values of parameters which drives natural capital dynamics (r , CT , CC) would be a useful piece of information.
- To my understanding there is missing feedback btw natural capital and output ($CC \rightarrow 0 \Rightarrow$ Solow growth model)
- The issue could be solved by making natural capital a factor of production (better within a CES) or by linking choices of consumption to natural capital.