Quantitative Economics for the Evaluation of the European Policy

Dipartimento di Economia e Management

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- Augmented Solow model proposed some **determinants** (investment rate, growth rate of employment, and human capital) with explanatory power with respect the growth of European regions.
- **Nonlinearities** in the estimates are a very common feature
- **Absolute and/or conditional convergence** is not guarantee (initial GDP per worker is not always negatively related to average growth rate of regions)
- **Polarization** of GDP per worker appears a persistent phenomenon (twin-peaked distribution)

- Solow model with poverty trap or better **multiple equilibria** (but why only two?)
  - **endogenous investment rate**
  - **endogenous growth rate of population**
  - **increasing returns to scale (change in output composition)**
  - **endogenous level of human capital**
- Solow and **limited technological spillovers**
- Solow with open economy and **factor reallocation** across regions
- Solow with open economy, factor reallocation across countries, and limited technological spillover
- Solow with **two sectors** and factor reallocation across regions (core-periphery, i.e. North-South model)
- Solow with **many intermediate goods**

What is particular for European regions?

- The **geographical distance** between regions is not so high $\Rightarrow$ technological spillovers and factor allocation should be present.
- There exists a strong **country component** with regard to many economic variables, among which fiscal policy, norms and language, which partially impedes these phenomena to fully operate.
- Over time there is a progressive increase of **integration** of European regions due to European Policy.

Solow model with multiple equilibrium

From the standard Solow model we have that:

$$\dot{k} = sf(k,h) - (\delta + g_A + n)\,k, \tag{1}$$

where

$$k \equiv \frac{K}{AL}\ ,\ f \equiv F\left(\frac{K}{AL}, h\right)\ \text{and}\ f_k > 0, f_{kk} < 0 \tag{2}$$

and s is the exogenous saving/investment rate, h the level of human capital, δ the depreciation rate of physical capital, g_A the growth rate of technological change, and n the growth rate of employment.
Key assumptions are that s and n are **exogenous**. But what if they are determined by some economic force?

Endogenous saving/investment rate

Suppose:

$$s = s(k) \tag{3}$$

with $s' > 0$ and $s'' < 0$.
A possible explanation of this positive relationship between saving rate and capital is in the existence of a minimum level of consumption, i.e. suppose that total consumption is a linear function of income as follows:

$$C = \bar{C} + cY \tag{4}$$

then:

$$s = \frac{Y - C}{Y} = \frac{Y - \bar{C} - cY}{Y} = 1 - c - \frac{\bar{C}}{Y} = 1 - c - \frac{\bar{c}}{y}, \tag{5}$$

where $\bar{c} \equiv \bar{C}/AL$ is assumed to be constant.

Endogenous saving/investment rate (cont.d)

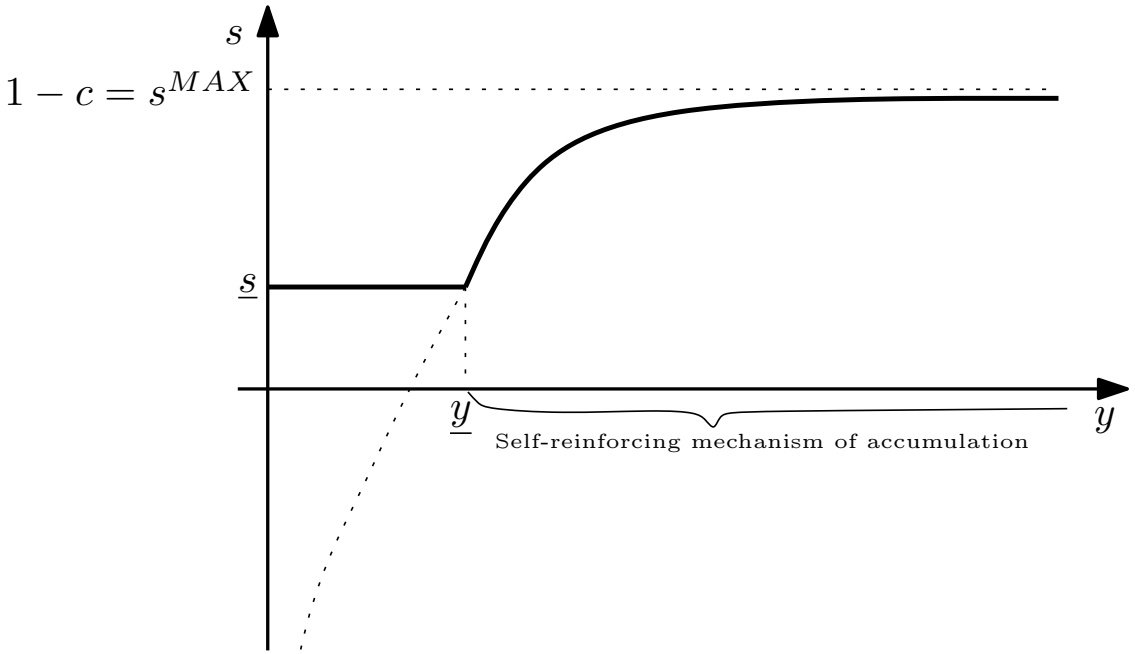


Figura: Endogenous saving rate

Key points

- It is empirically plausible that there exists a minimum saving rate $\underline{s}$ instead of negative or zero
- s^{MAX} is the maximum level of saving rate

The positive relationship between k and y leads to Eq. (3)

Multiple equilibria

$$\dot{k} = s(k)f(k,h) - (\delta + g_A + n)\,k$$

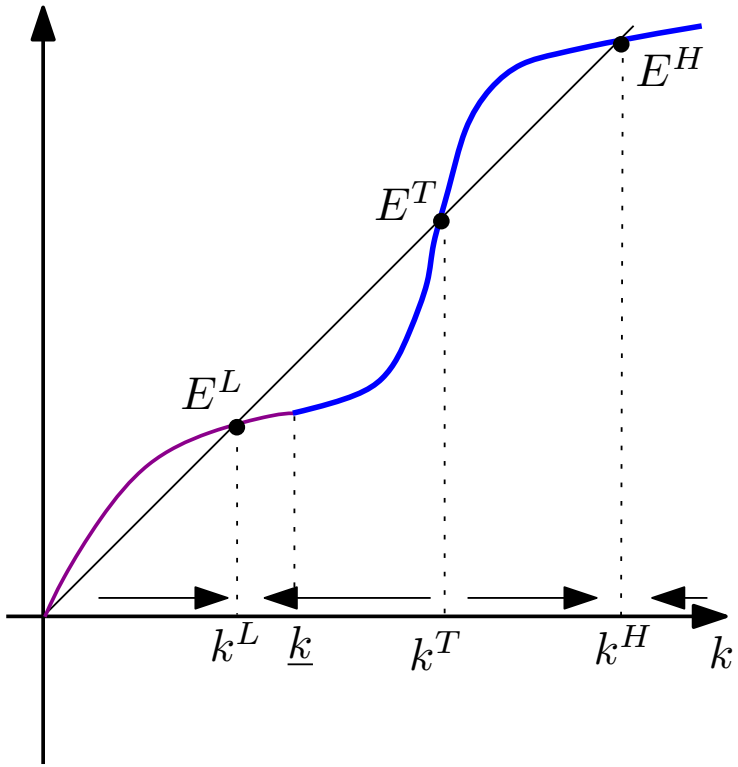


Figura: Multiple equilibria due to endogenous investment rates

Key points

- The change in concavity in $\underline{k}$ corresponds to the increase in s with respect to y
- There exist two stable equilibria E^L and E^H, and an unstable equilibrium E^T;
- Any economy with an initial k lower (higher) than k^T will converge to E^L (E^H);

The empirical implications of multiple equilibria

Two key points about multiple equilibria:

- With endogenous saving/investment rates we can observe the formation of **two clusters of regions** in terms di GDP per worker.
- These two clusters differs for their **average level of investment rates**.

Policy implication of multiple equilibria

- A policy helping a region to overcome the threshold level of capital k^T, for example by a **loan**, is a Pareto optimum because the increasing level of income would allow the region to pay back its debt in the future.
- This policy would be a **waste of resources** in a world with constant saving rates, i.e. where **conditional convergence** is the true model, because in the long run the poor regions will come back to their low equilibrium.
- It is not possible to identify the reasons of the existence of two clusters of countries by just observing their equilibrium levels of income: they are **observationally equivalent** because we would observe a cluster of regions with high (low) income and high (low) investment rates in both theories!

Conditional convergence versus poverty trap

$$\frac{\dot{k}}{k} = s(k)\frac{f(k,h)}{k} - (\delta + g_A + n)$$

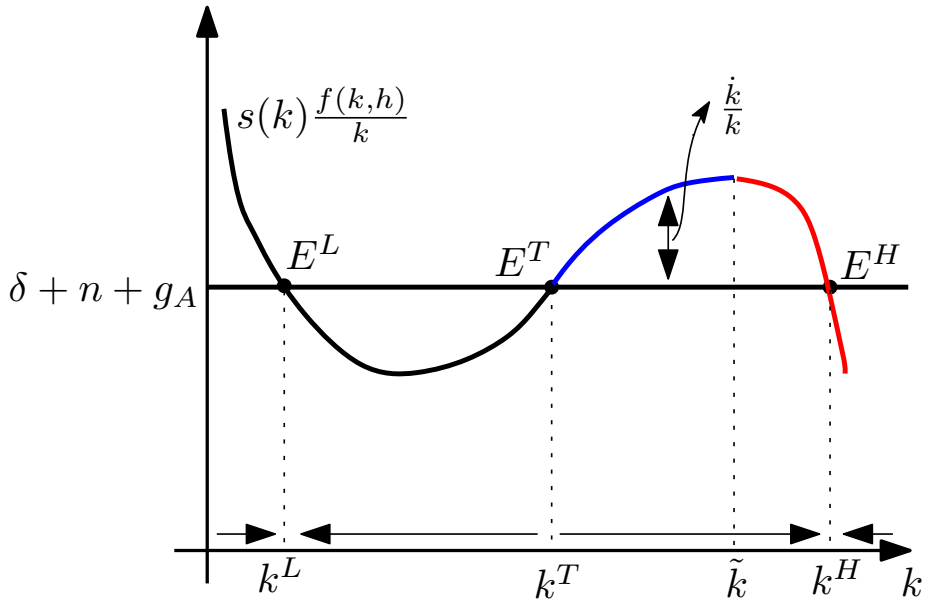
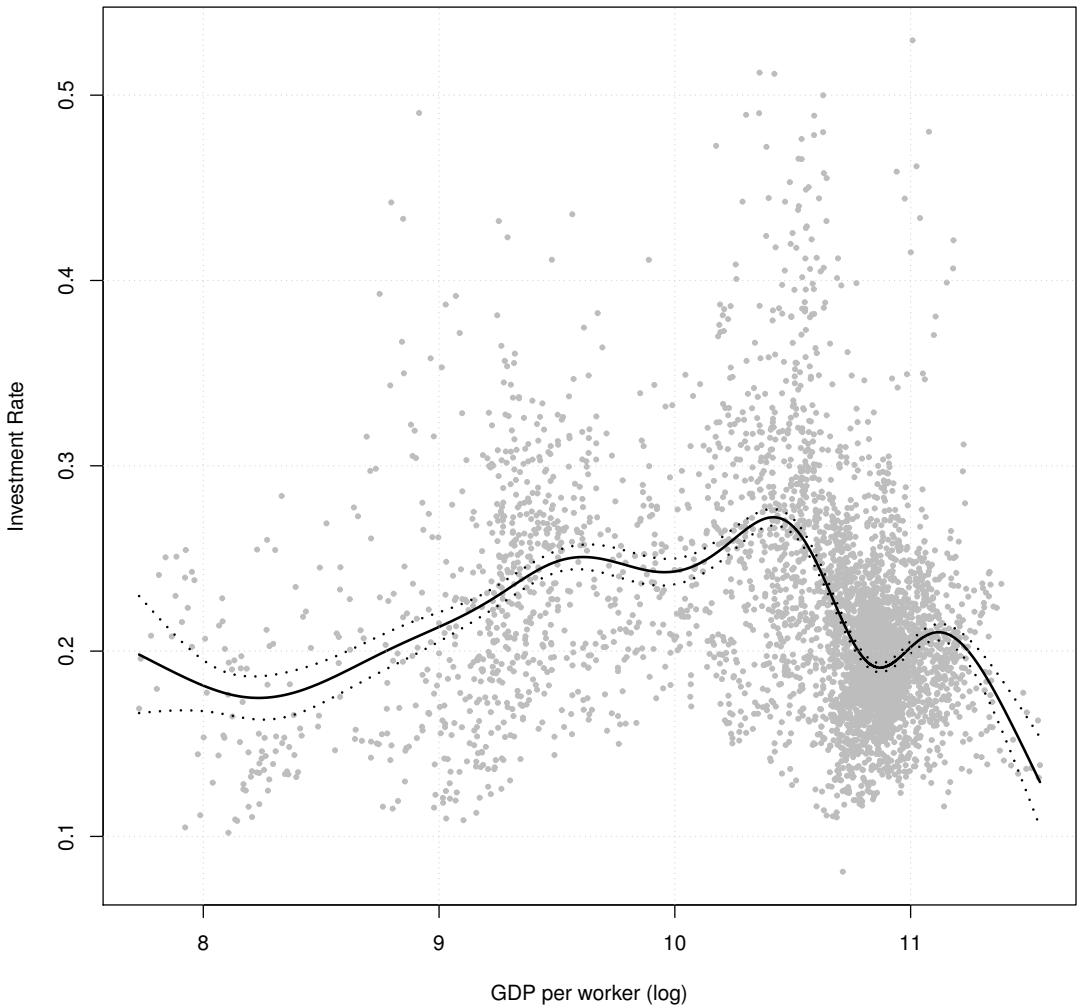


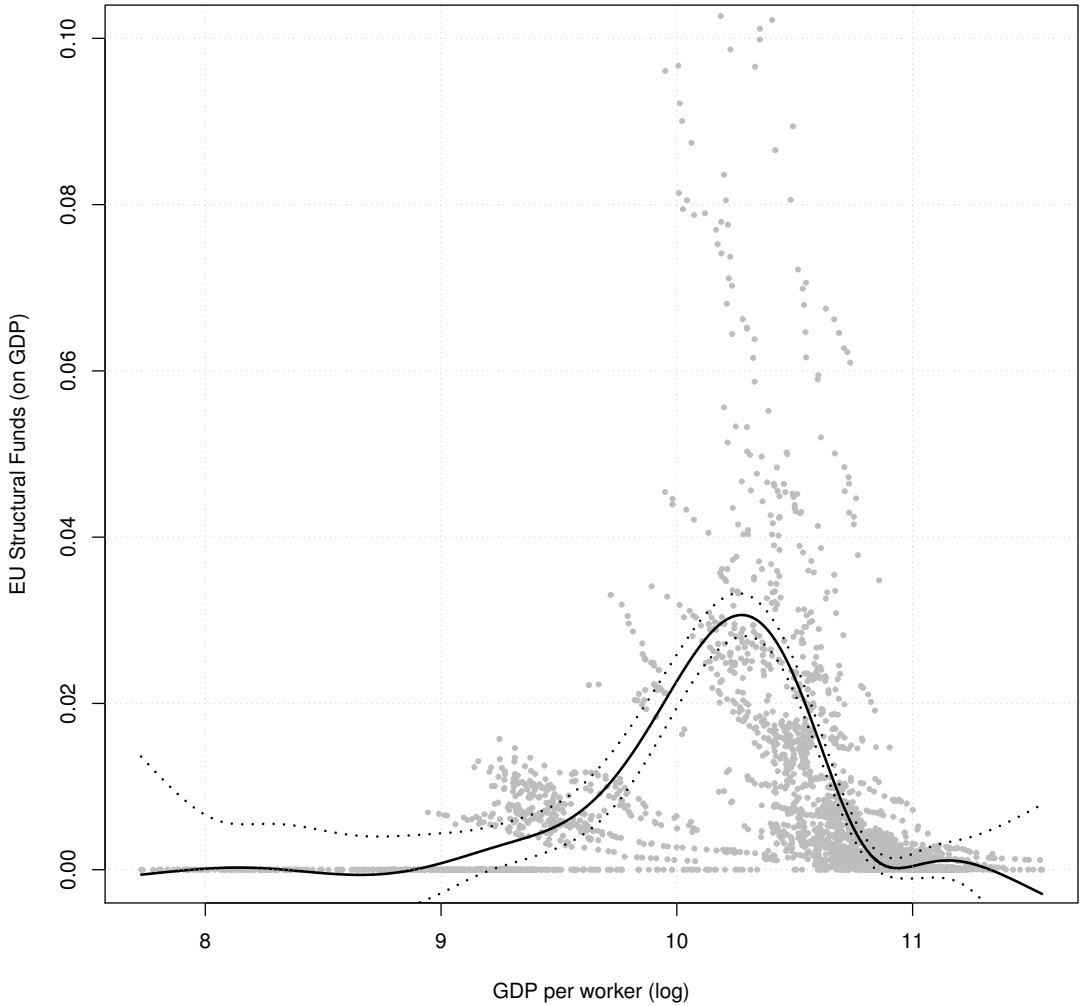
Figura: Growth rates with multiple equilibria due to endogenous investment rates

- Only observing the **transition to equilibrium**, and in particular the accelerating growth rate in the range $\left(k^T, \tilde{k}\right)$, denoted the **take-off phase**, is possible to distinguish the two models.

Investment rate versus GDP per worker



Structural funds (% of GDP) versus GDP per worker



Investment rate versus structural funds (% of GDP)