

Geographical Economics

Course 4: Convergence

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What did we learn ?

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2. Key role of the technology.

What are we learning ?

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1. Empirical issues associated with the growth processes,
2. Convergence/divergence issues.

Empirical application: growth accounting

- ▶ Decomposition of the growth of the output per-worker into the contribution of the growth of capital per workers and other remaining residuals \implies *Solow residual*

Empirical application: convergence

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- ▶ Differences in output arises when countries settle at different points of their balanced path
- ▶ One would expect poor countries catch-up to the rich countries

Empirical application: convergence

Key equation:

$$\ln \left[\left(\frac{Y}{N} \right)_{i,t} \right] - \ln \left[\left(\frac{Y}{N} \right)_{i,t_0} \right] = a + b \ln \left[\left(\frac{Y}{N} \right)_{i,t_0} \right] + \varepsilon_i$$

- ▶ In case of convergence: $b < 0$: if $b = -1$ perfect convergence

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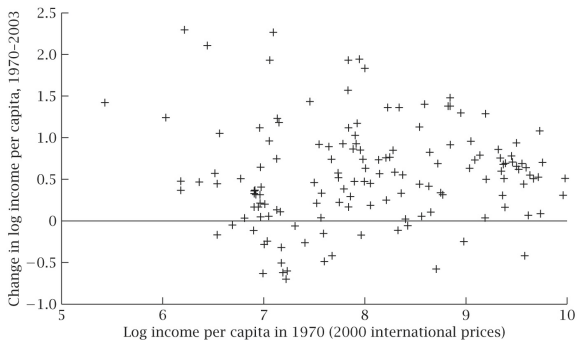
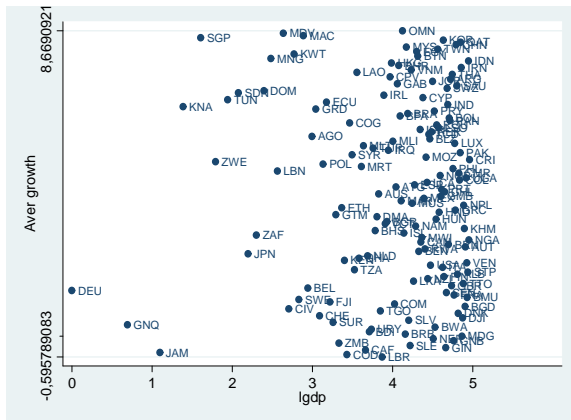
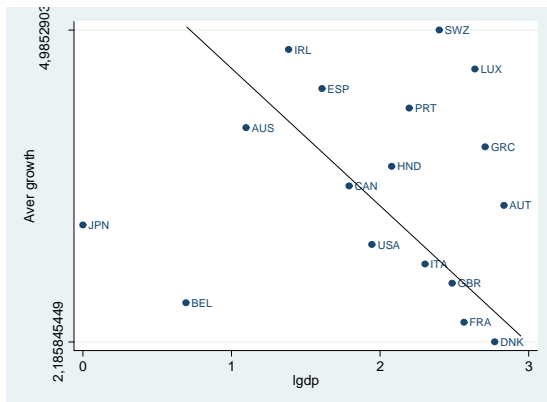


FIGURE 1.9 Initial income and subsequent growth in a large sample

Empirical application: convergence



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- ▶ β or unconditional convergence
- ▶ σ or conditional convergence

Further issues about growth

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$$Y(t) = [A(t)L(t)]^\alpha K(t)^{(1-\alpha)}$$

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- ▶ One of the most convenient way to represent a production function is the Cobb-Douglas function:

$$Y(t) = [A(t)L(t)]^\alpha K(t)^{(1-\alpha)}$$

- ▶ It is a very flexible representation and it allows for several extensions: for instance, including *natural resources*

$$Y(t) = K(t)^\alpha R(t)^\beta T(t)^\gamma [A(t)L(t)]^{1-\alpha-\beta-\gamma}$$

Further issues about growth

- ▶ **Endogenous growth:** the growth process is driven by factors not suffering from decreasing returns to scale.

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$$Y(t) = [(1 - a_k)K(t)]^\alpha [(1 - a_L)A(t)L(t)]^{1-\alpha}, \alpha > 0,$$

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- ▶ Labor effectiveness is driven by the creation of knowledge, for instance, with R&D (namely, creation of new ideas)

$$\dot{A}(t) = \underbrace{A(t)^\theta}_{\text{Stock HC}} B [(a_k)K(t)]^\beta [(a_L)L(t)]^{1-\beta}$$

Further issues about growth

- ▶ Key issue: importance of the returns to scale

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$$\dot{A}(t) = BK(t)^\varphi; \varphi > 0 \text{ \& } B > 0.$$

Further issues about growth

- ▶ Key issue: importance of the returns to scale
- ▶ **Exogenous vs endogenous growth:** for specific values of the parameters, increases in the saving rates and in the population increase the long run growth.

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- ▶ **Exogenous vs endogenous growth:** for specific values of the parameters, increases in the saving rates and in the population increase the long run growth.
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- ▶ **Other source of endogenous growth: *learning by doing***

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Further issues about growth: including human capital

$$Y(t) = [A(t)H(t)]^\alpha K(t)^{(1-\alpha)}$$

$$\dot{K}(t) = sY(t) - \delta K(t)$$

$$\dot{A}(t) = gA(t)$$

$$\dot{H}(t) = L(t)G(E); \quad G_I > 0 \text{ \& } G_{II} ??$$

$$\dot{L}(t) = nL(t)$$

$$G(E) = e^{\phi G(E)}$$

Further issues about growth: including human capital

In the balanced growth path

$$\frac{Y}{L} = AG(E)y$$

- ▶ Human capital influences the rate of growth and it can help to explain differences in income across countries. Intuition: education alters the output per-person on the balanced growth path by the same proportion.

Further issues about growth: including human capital

In the balanced growth path

$$\frac{Y}{L} = AG(E)y$$

- ▶ Human capital influences the rate of growth and it can help to explain differences in income across countries. Intuition: education alters the output per-person on the balanced growth path by the same proportion.
- ▶ The existence of human capital does not change the Solow model's implications about the effects of physical capital.

Further issues about growth: empirical analysis about human capital

Common function to be estimated (for a country i):

$$\ln\left(\frac{Y_i}{L_i}\right) = \frac{\alpha}{1-\alpha} \ln\left(\frac{K_i}{Y_i}\right) + \ln \frac{H_i}{L_i} + \ln A_i$$

- ▶ Data sources: Penn World tables

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- ▶ Data sources: Penn World tables
- ▶ Principal issues:
 - 1/6 gap between richest and poorest countries is due to physical capital
 - 1/4 gap between richest and poorest countries is due to schooling

Further issues about growth: other factors

The basic setting can be augmented by using other factors that may explain differences in income across countries:

- ▶ **Social infrastructure:** this means institutions and policies that help enhancing the returns of the physical and human capital.

Further issues about growth: other factors

The basic setting can be augmented by using other factors that may explain differences in income across countries:

- ▶ **Social infrastructure:** this means institutions and policies that help enhancing the returns of the physical and human capital.
- ▶ **Geography:** it covers a range of factors from the simple idea of land composition to the spirit of clustering.