Robert Lucas: Some Macroeconomics for the 21st Century

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1. Prior to roughly 1800, there were not large differences in the levels of income per capita between countries.

2. The poorest countries in the world today have roughly the same level of income per capita that they did prior to 1800.

3. Since 1800, more and more countries have joined the group experiencing “modern economic growth.” The richest countries in the world today are generally those that started growing earliest.

4. Countries which started growing earliest, such as the United Kingdom and the United States, have experienced roughly constant growth rates of income for most of the period since 1800. Countries that started to grow later, such as Japan, have experience bursts of rapid growth as they moved to catch up with the leading countries.
Lucas argues that the situation can be thought of as being analogous to a horse race with two important differences.

1. In a normal horse race, all of the horses get to start at the same time. By contrast, countries have entered into process of growth at different times.

2. Countries that start later get an advantage from being behind.
First Country to Start Growing

t indexes time

s indexes date on which a country started growing

\( y(s, t) \) is output per capita at time \( t \) in a country which started growing at date \( s \).

\( s = 0 \) is the date on which the first country started growth.

The growth rate of that country is \( \alpha \) and initial income is \( y_0 \), so

\[ y(0, t) = y_0 (1 + \alpha)^t \]

Parameter Values:

\( \alpha = .02 \), which is roughly the growth rate of the US since the middle of the 19th century.

time zero = 1800

\( y_0 \approx $600 \)
Two components to growth:

1) trend productivity growth

2) a catch-up factor greater than one

\[
\frac{y(s, t + 1)}{y(s, t)} = (1 + \alpha) \left( \frac{y(0, t)}{y(s, t)} \right)^eta
\]

or in continuous time, with the usual log approximations:

\[
\frac{\dot{y}}{y} = \alpha + \beta [\ln(y(0, t)) - \ln(y(s, t))]
\]

Lucas looks at the data and says that \( \beta = .025 \)
Countries that start to grow later get an “entrant bonus” from being behind.

Suppose that $s = t$, in other words, a country starts to grow at time $t$.

at time $t$, lead country has income $y(0, t) = y_0 + \alpha t$

thus applying the formula for growth

$$\frac{\dot{y}}{y} = \alpha + \beta [\ln(y(0, t)) - \ln(y(s, t))] = \alpha + \beta [y_0 + \alpha t - y_0] = \alpha + \alpha \beta t$$

So:

A country that starts to grow in 1850 begins at 4.5% per year
A country that starts to grow in 1900 begins at 7% per year
A country that starts to grow in 1950 begins at 9.5% per year
A country that starts to grow in 2000 begins at 12% per year
Figure 1
Income Paths, Selected Economies

Parameter Values:
\[\alpha = .02\]
\[\beta = .025\]
\[ \lambda(t) = \text{hazard of a non-growing country starting to grow at time } t \]

\[ \lambda_m = \text{hazard when the whole world was poor (prior to 1800)} \]

\[ \lambda_M = \text{hazard when the whole world is rich} \]

\[ x(t) = \text{average world income at time } t \]

\[ \lambda(t) = \lambda_m \exp(-\delta[\ln(x(t)) - \ln(y_0)]) + \lambda_M (1 - \exp(-\delta[\ln(x(t)) - \ln(y_0)]) \]

Lucas picks the values \( \lambda_m = .001, \lambda_M = .03, \text{ and } \delta = .5 \)
Fraction of Economies Growing

Figure 2
Fraction of Economies Growing, by Year

Parameter Values:
\[ \alpha = .02 \]
\[ \beta = .025 \]
\[ \lambda_{\text{min}} = .001 \]
\[ \lambda_{\text{max}} = .03 \]
\[ \delta = .5 \]
Figure 3
World Growth Rate and Income Variability

Parameter Values:
\[ \alpha = 0.02 \]
\[ \beta = 0.025 \]
\[ \lambda_{\text{min}} = 0.001 \]
\[ \lambda_{\text{max}} = 0.03 \]
\[ \delta = 0.5 \]
Measure of inequality is mean log deviation from world mean.

Source: Bourguignon and Morrison (2002)

==> Since the end of the data (1992), between-country inequality (pop weighted) has clearly declined.
Open Questions from Lucas Framework

- Why is growth in the lead countries so constant?
- What determines when a country exits the starting gate?
- What is “under the hood” that makes countries grow?
  - technological change
  - demographic transition
  - change in investment rate
  - change in human capital accumulation
  - massive sectoral shifts
- Why are we talking about countries anyway?