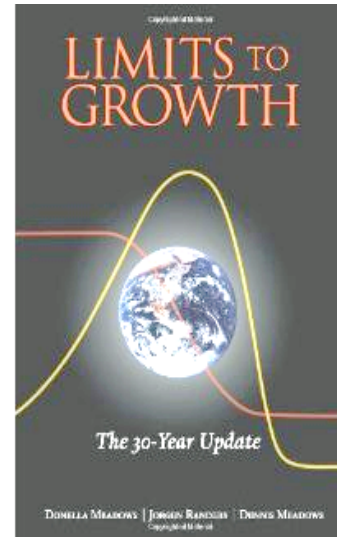
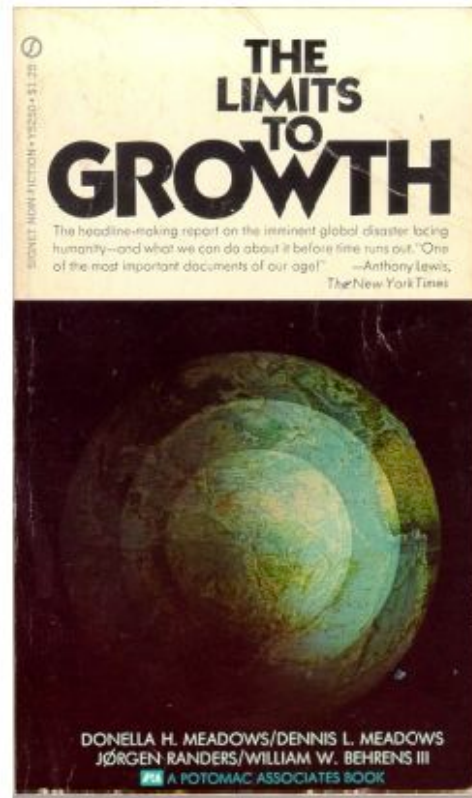


1972



Growth?

- What is growth?

Water lilies

There is a pond in which water lilies grow.

The lilies double in size each day.

At this rate of growth the water lilies will completely cover the pond in 30 days.

On what day will the pond be half-full of water lilies?

<https://elearning.ec.unipi.it/mod/feedback/view.php?id=21821>



- <https://elearning.ec.unipi.it/mod/feedback/view.php?id=28718>

What would you prefer ... being given
A) 10 millions euro
B) or one penny the first day,
double that penny the next day,
then double the previous day's pennies and so on
for 30 days

$$\text{Amount} = 0.01 * 2^{30} - 1 =$$

€ 10 737 418.23

On geometric progression see
https://areweb.polito.it/didattica/polymath/htmlS/argoment/ParoleMate/Ott_08/ProgrGeom.htm

On the difference between linear and exponential growth see
<https://demonstrations.wolfram.com/ExponentialAllowanceRiddle/>

US, South Korea, Japan, Italy

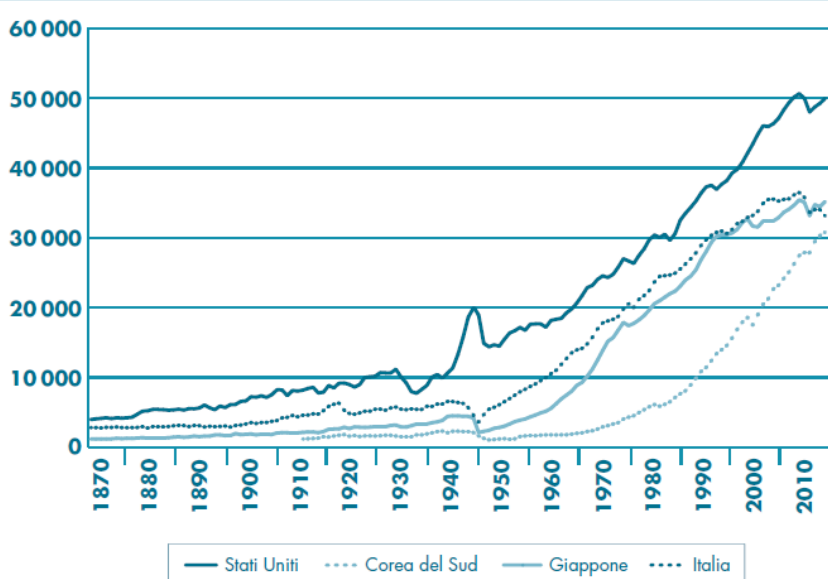


Figura 16.1
PIL pro capite, 1870-2012
Paesi: Stati Uniti, Corea del Sud, Giappone, Italia.

(Fonti: Maddison A., *Statistics on World Population, GDP and Per Capita GDP, 1-2006AD, 2009*; Maddison A., *The World Economy, A Millennial Perspective*, OECD, Paris 2001; IMF (International Monetary Fund), *World Economic Outlook Database*, October 2013).

US and emerging economies ...

Figura 16.2
PIL pro capite, 1870-
2012
Paesi: Stati Uniti, Cina,
Brasile, India.

(Fonte: vedi Figura 16.1.)



Growth and RATE of GROWTH

$$y_t = 200$$

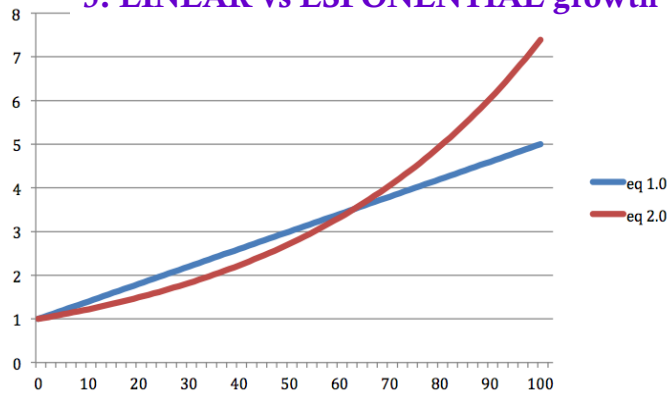
$$y_{t+1} = 210$$

$$\frac{\Delta y}{\Delta t} = 10$$

$$\frac{\Delta y}{y \Delta t} = \frac{10}{200}$$

$$\frac{\Delta y}{y \Delta t} = \frac{5}{100} \quad 5\%$$

5. LINEAR vs ESPONENTIAL growth

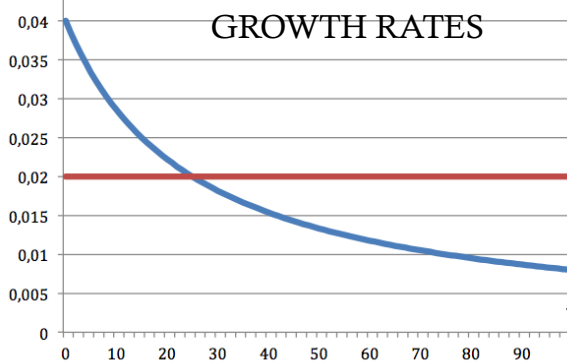


TWO different time patterns

$$(1.0) y_t = a + bt$$

$$(2.0) y_t = ae^{\rho t}$$

0 NB: valori dei parametri $a=1, b=0.4, \rho=0.02$



$$\frac{dy}{dt} \frac{1}{y_t} = \rho$$

$$\frac{dy}{dt} \frac{1}{y_t} = \frac{b}{a + bt}$$

PREMISE: in the 1960s growth was seen as automatically promoting equity

Without economic growth, improving the lot of the poor means taking away from the rich.

The rich generally resist, and anyway are few in number. With total output constant, poverty alleviation through redistribution involves social conflict and will, the argument goes, be largely ineffective.

But if total output grows exponentially over time, then the lot of the poor can be improved without redistribution.

In the early post-World War II period economic growth became the paramount objective of policy worldwide mainly, but not solely,

because it alone was seen as the means to reduce the human suffering that poverty involved (Arndt 1978).

The Limits to Growth (Meadows et al. 1972) **reported the results of experiments with a computer model** of the global economic system and its interdependencies with the natural environment.

It was a challenge to economic growth as the pre-eminent global policy objective based on feasibility considerations arising from the location of economic activity within an environment which is a thermodynamically closed system.

With very few exceptions, the reaction to The Limits to Growth by **economists was dismissive and hostile.**

The judgement by one economist that the book was “a brazen, impudent piece of nonsense that nobody could possibly take seriously” (Beckerman 1972) was representative of the substance of most economists' reaction, if expressed somewhat more robustly than was typical.

According to most of its economist critics, what *The Limits to Growth* said was that

the world economy **would collapse in the twenty-first century due to the exhaustion of its stocks of mineral resources.**

Indeed, one still today comes across statements by economists that this is what the book said, followed by the observation that

known reserves are today generally higher than they were in 1972,

which shows that the book was nonsense and that there are no environmental limits to growth.

Economists: PRICES signal scarcity and drive innovations!

Such accounts of the content of *The Limits to Growth* are completely erroneous,

and appear to reflect having read only the first couple of chapters.

It is **true** that the **first model run** reported did show collapse as the consequence of resource depletion (not exhaustion).

However, in the next reported run, the model was modified by an increase in the resource availability limit such that depletion did not give rise to problems for the economic system.

In this run, the proximate source of disaster was **the level of pollution** consequent upon the exploitation of the increased amount of resources available.

This consequence follows from the law of conservation of matter, generally ignored in economics.

A number of variant model runs were reported, each relaxing some constraint.

The conclusions reached were based on consideration of all of the variant model runs.

The Limits to Growth did not conclude that disaster is inevitable.

It did conclude that it was probable on current trends, and that:

it is possible to alter these trends

and to establish a condition of ecological and economic stability that is sustainable far into the future.

The state of global equilibrium could be designed so that the basic material needs of each person on earth are satisfied and each person has an equal opportunity to realise his or her individual human potential

(Meadows et al. 1972, p. 23).

Its results had the clear implication that

global economic growth could have only a minor role in eliminating poverty;

achieving sustainability and eliminating poverty would require major international redistribution of wealth.

For most economists this is as unpalatable

as the conclusion - the inevitability of disaster - that many falsely attribute to The Limits to Growth.

The different reactions by economists to the Brundtland Report and The Limits to Growth are interesting.

In both cases, environmental problems associated with growth are identified and discussed.

In both cases, it is argued that it is impossible to conceive that current trends can be continued far into the future without creating major economic problems.

HOWEVER ...

The Limits to Growth (1972) offers sustainability in the sense of

a constant level of total world output which can be maintained into the indefinite future.

Implicit is the continuing existence of pressure for redistribution from rich to poor nations.

In contrast, the Brundtland Report

does not **require** the cessation of economic growth