

From stagnation to economic growth: 1600–2100

David de la Croix

Department of economics – IRES & CORE
Univ. cath. Louvain



Faculteit Economie en Bedrijfskunde
Binnenlandse Francqui Leerstoel

Question

- ♦ Move from economic stagnation to sustained growth around 1820. Why?
- ♦ Income per capita (Belgium) 2001 vs 1820
 $20924 / 1319 = 16$
- ♦ Gap between Belgium and Africa:
 $1319 / 420 = 3$ in 1820
 $20924 / 1489 = 14$ in 2001
- ♦ Numbers from Maddison (2001)

Question

- ♦ Main driving forces behind « The Industrial Revolution »
→ understand our own history
→ understand the existing gap between poor and rich countries

Answers

- ♦ Early attempt to have a dynamic « theory » of growth and development:
Walt Rostow and its stages of growth (60s)
- ♦ Revival of the question – quantitative approach:
 - build formal theories consistent with the facts (« economic models »)
 - Help from historians – data sets

Content

- ♦ Review of selected facts.
- ♦ Review of recent explanations:
 - technology,
 - right institutions,
 - population threshold,
 - mortality decline.
- ♦ Summary and Forecasts

♦ Facts

- Total income growth
- The demographic transition
- Mortality
- Forerunners of fertility control
- Literacy – education – cities

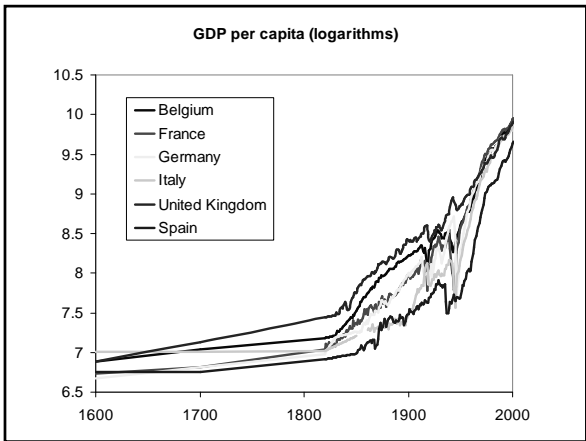
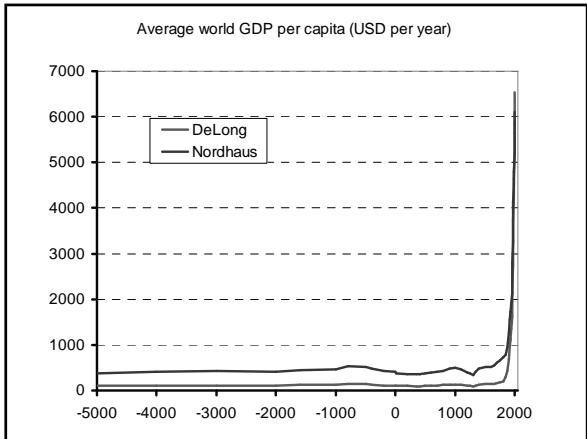
♦ Explanations

- Technical progress
- Right institutions
- Population threshold
- Early mortality decline

♦ Forecasts

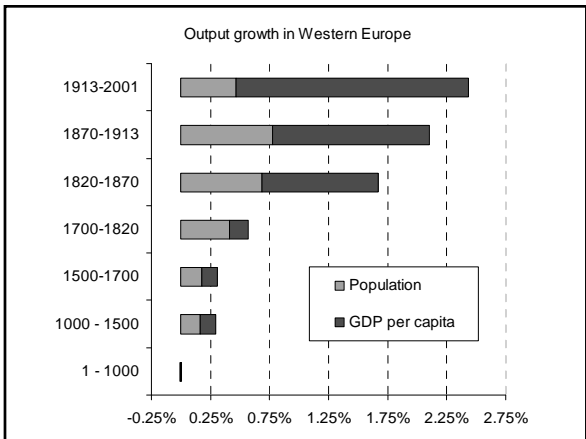
Income growth

- ◆ World data – very long term perspective
 - J. Bradford DeLong, Estimating World GDP, One Million B.C. – Present, Department of Economics, U.C. Berkeley
- ◆ Data by countries
 - A. Maddison, The World Economy – a Millennial Perspective, OECD
- ◆ Real wages for England over 600 years



Europe dynamics

- ◆ 1700–1820: England emerges as the leader:
 - Grow faster than any other European country
 - Urbanisation ratio rose sharply, in contrast to elsewhere in Europe
- ◆ 1820–: acceleration of real income growth + convergence in Western Europe



Three regimes

- ◆ Malthusian stagnation:
 - Income per capita roughly constant
 - Slow growth of population
 - Negative shock to population → higher wages
- ◆ Post-Malthusian regime:
 - Acceleration in both growth in income per capita and population
- ◆ Modern growth:
 - Rapid growth in income per capita
 - Deceleration of population growth

From Malthus to Solow

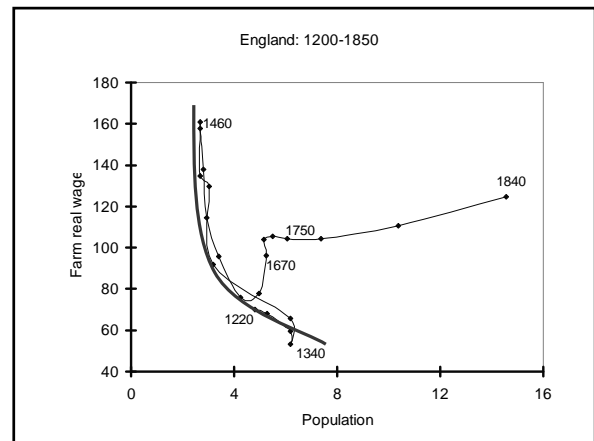


Real wage data

- ◆ G. Clark calculates real day wages for agricultural laborers

G. Clark, **The Long March of History: Farm Laborers' Wages in England 1208-1850**, UC Davis

- ◆ Comparison between real wages and population (proxy for labor input).



◆ Facts

- Total income growth
- The demographic transition
- Mortality
- Forerunners of fertility control
- Literacy - education - cities

◆ Explanations

- Technical progress
- Right institutions
- Population threshold
- Early mortality decline

◆ Forecasts

The demographic transition

- ◆ Change from

Stable/increasing population with high fertility and mortality

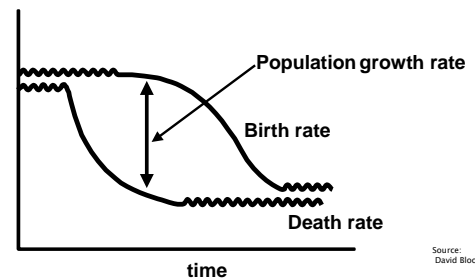
- ◆ To

Stable/declining population with low fertility and mortality

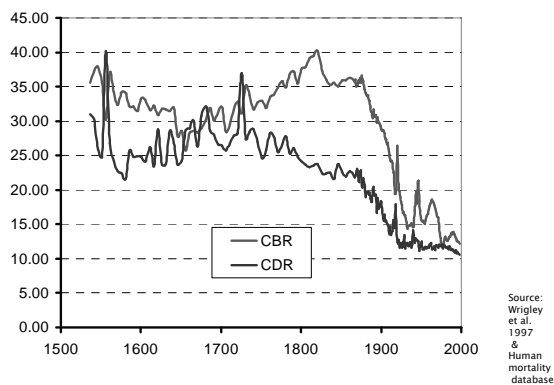
The demographic transition

- ♦ Mortality drops first, then birth rates fall
- ♦ Population increased during the process
- ♦ Age structure changes

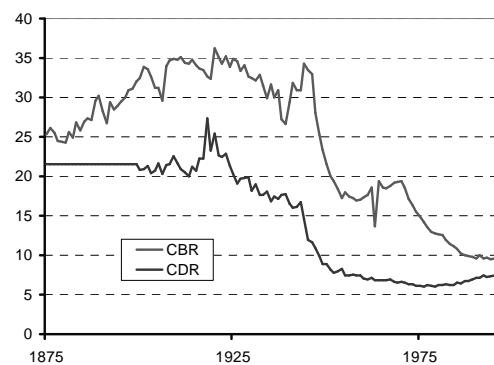
The demographic transition



The English demographic transition



The Japanese demographic transition



Length of the transition

- ♦ In England: two centuries
- ♦ In Japan: less than a century (even shorter in other countries, e.g. Taiwan)
- ♦ Now, generalized to the whole world

A good explanation of the take off should not contradict the demographic transition

♦ Facts

- Total income growth
- The demographic transition
- Mortality
- Forerunners of fertility control
- Literacy - education - cities

♦ Explanations

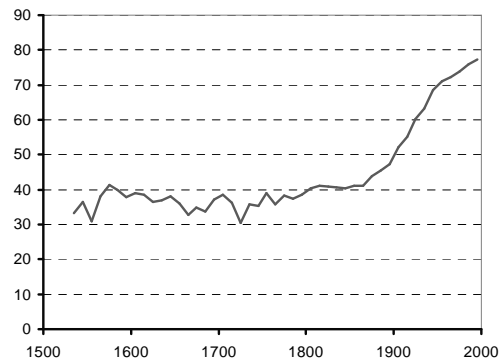
- Technical progress
- Right institutions
- Population threshold
- Early mortality decline

♦ Forecasts

Mortality

- ◆ Life expectancy at birth:
 - No improvements before 1800
 - But reduction in variability

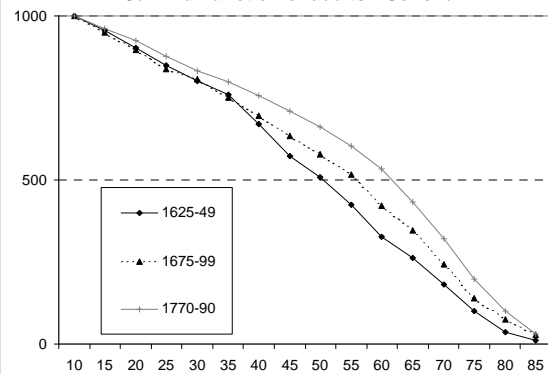
Life expectancy at birth - England



Adult mortality

- ◆ Life expectancy at birth is affected very much by infant mortality
- ◆ To study adult mortality, we need life tables (age specific mortality rates)
- ◆ 3 data sets available prior to 1800:
 - Geneva (Perrenoud)
 - Venice (Beltrami)
 - England (Wrigley et al. - family reconstruction)

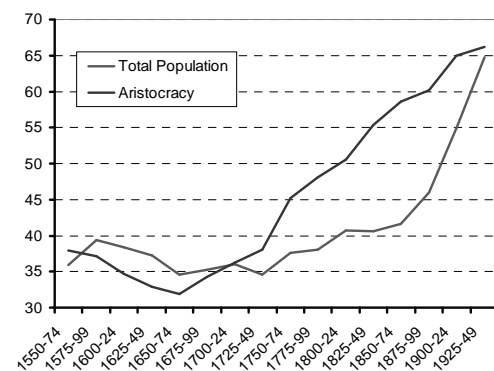
Survival function of adults - Geneva



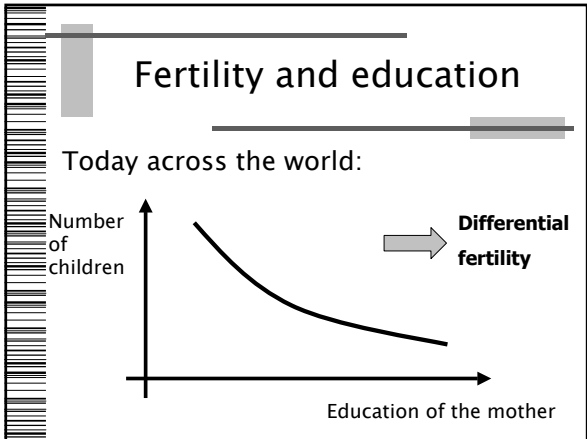
Mortality by social class

- ◆ Using genealogical data, Hollinsworth provides demographic data for the British aristocracy
 - Before 1700, urban penalty
 - Over 1700-1850, the elite's mortality fell more rapidly

Life expectancy at birth - England

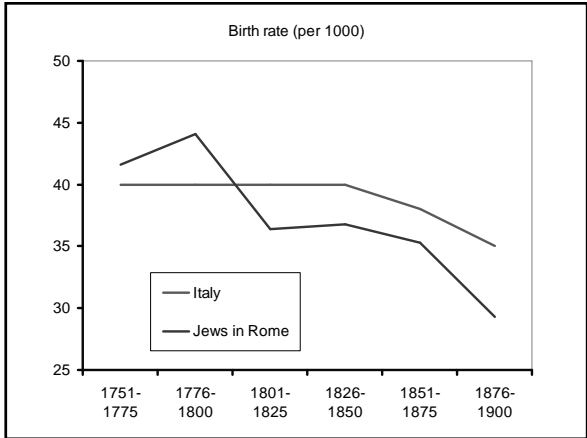
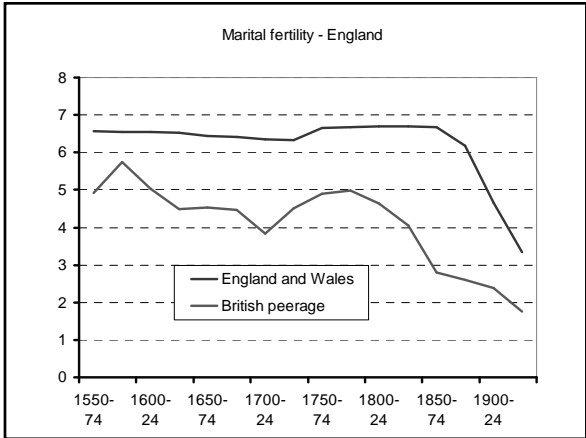


- ◆ Facts
 - Total income growth
 - The demographic transition
 - Mortality
 - Forerunners of fertility control
 - Literacy - education - cities
- ◆ Explanations
 - Technical progress
 - Right institutions
 - Population threshold
 - Early mortality decline
- ◆ Forecasts



- ### Quality/quantity tradeoff
- ◆ Family economics: *tradeoff* between the number of children and education spending for each child.
 - ◆ For educated women (high wage): the opportunity cost of child-rearing time is high -> small number of children and high quality.
 - ◆ For less-educated women (low wage): providing education is expensive relative to their income -> many children.

- ### Forerunners of fertility control
- ◆ Fertility decline: who were forerunners ?
 - Aristocrats
 - Jews
 - People living in cities



Forerunners

- ◆ Forerunners have similarities
 - Urban connection
 - Moderate mortality ?
 - Above-average economic level
- ◆ Two competing explanations
 - Child-replacement hypothesis
 - Quantity-quality tradeoff

◆ Facts

- Total income growth
- The demographic transition
- Mortality
- Forerunners of fertility control
- Literacy - education - cities

◆ Explanations

- Technical progress
- Right institutions
- Population threshold
- Early mortality decline

◆ Forecasts

Literacy - issues

- ◆ Has literacy favored the Industrial Revolution? (Cipolla, Literacy and development in the West)
- ◆ What we know:
 - Around 1600, very few can sign with their name
 - Continuous progresses over 1600-1800
 - Compulsory public education voted around 1870

Literacy in 1600

- ◆ Illiteracy : major problem in 1600.
- ◆ Anecdotes:
 - « In 1607 the Venetian government appointed a commission of four naval officers to decide upon the kind of ships to be used in a war against the pirates. They must have been officers of quality to be chosen for such a purpose; among the four officers, three of them signed their names with a cross. » (Cipolla)

Parish registers

marriage record from the register for Notgrove, in 1791

Marriage between *Zachariah Williams* and *Anne Hooper* was solemnized in the Parish of *Notgrove* on the *24th* Day of *December* in the Year One Thousand Seven Hundred and *Twenty One* by me *Zachariah Williams* Minister of the Gospel and *Joseph Hooper* Curate of the said Parish in the Presence of *Zachariah Williams* and *Joseph Hooper* Witnesses.

Parish *Notgrove*

Married in this *Parish* by *Zachariah Williams* Minister of the Gospel and *Joseph Hooper* Curate of the said Parish in the Year One Thousand Seven Hundred and *Twenty One* by me *Zachariah Williams* Minister of the Gospel and *Joseph Hooper* Curate of the said Parish in the Presence of *Zachariah Williams* and *Joseph Hooper* Witnesses.

Zachariah Williams (who signs)

Anne Hooper (who makes an X mark)

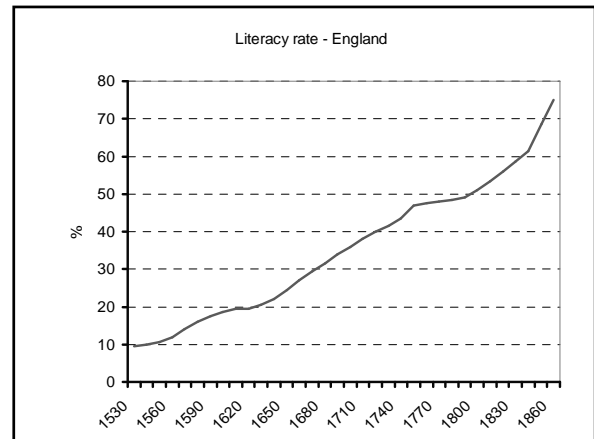
Improvements in France

- ◆ French survey in 1877 by Maggiolo.
- 15,928 teachers counted signatures on marriage registers. They treated half a million documents covering two periods.
- ◆ % of newly married people signing with marks:

	1686-90	1786-90
	79	63

Improvements in England

- ♦ Very early rise
- ♦ Significant achievements before any compulsory public schooling
 - Source: Cressy, Literacy and the social order, CUP
- ♦ Both data sets – French and English – agree: large gains in literacy over the eighteenth century.

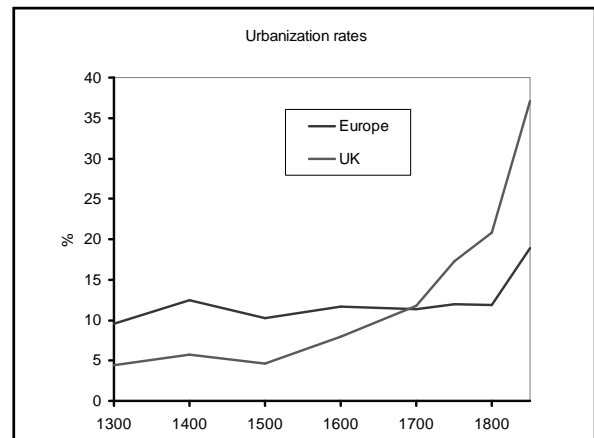


Literacy – urbanization

- ♦ Cities are important places to acquire education.
- ♦ Population of London:

Year	1500	1600	1700	1800
Population	50	200	575	948

Bairoch, Batou, Chèvre, The Population of European Cities from 800 to 1850



♦ Facts

- Total income growth
- The demographic transition
- Mortality
- Forerunners of fertility control
- Literacy – education – cities

♦ Explanations

- Technical progress
- Right institutions
- Population threshold
- Early mortality decline

♦ Forecasts

Technical progress

- ♦ Steady technical progress does not work because it cannot explain the early stagnation.
- ♦ One good, two technologies
 - « Malthus » technology requires land, labor and capital
 - « Solow » technology requires only labor and capital

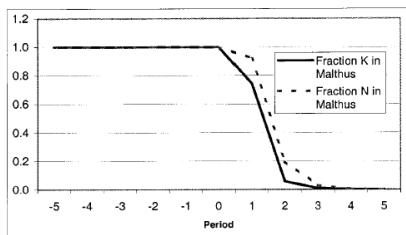
(Hansen Prescott, **Malthus to Solow**, AER, 2002.)

The Malthusian economy

- ♦ Land in fixed supply
- ♦ More workers → lower wages
 - This is why we observed, after the black death, a rise in real wages.
- ♦ Return to scales with respect to reproducible factors are decreasing

The Solow economy

- ♦ Uses only labor and capital → income per capita can grow in line with capital per worker
- ♦ If technological progress : the Solow sector will inevitably become profitable
- ♦ capital and labor are progressively shifted from the Malthusian sector to the Solow sector



- ♦ The transition from Malthus to Solow is inevitable

Coherence with other facts

- ♦ The shift to the modern « Solow » technology can be accompanied by a rise in returns to education
 - may explain the *late* improvements in education
 - + reduction in fertility
 - opportunity costs of having children has increased (wages of the mothers increased),
 - substitution quantity → quality.

Discoveries vs profitability

- the modern sector is not suddenly discovered, but becomes profitable at some point.
- Mokyr idea: « much growth is deployed from previously available information rather than the generation of altogether new knowledge. »

Weakness of the technology approach

- ♦ Where do technological improvements come from ?
- ♦ Why in the nineteenth century and not before or after ?
- ♦ Timing of literacy and adult mortality

◆ Facts

- Total income growth
- The demographic transition
- Mortality
- Forerunners of fertility control
- Literacy – education – cities

◆ Explanations

- Technical progress
- Right institutions
- Population threshold
- Early mortality decline

◆ Forecasts

Institutions

- ◆ Institutions: always been thought to be crucial for development.
- ◆ Many institutions can be invoked.
- ◆ Recently: interesting data and models on the link between the introduction of *public schooling* and the distribution of land.

Starting point

- ◆ Why richer countries like Spain and Portugal were overtook by England ?
- ◆ Same question for their colonies: why was the gold-rich Mexico overtook by Northern-American colonies ?

Proportion of household heads who own land

- | | |
|-----------------------|------|
| ◆ Mexico, 1910 | 2.4 |
| ◆ United States, 1900 | 74.5 |
| ◆ Canada, 1901 | 87.1 |
| ◆ Argentina, 1885 | 20 |

Engerman – Sokoloff, FACTOR ENDOWMENTS, INEQUALITY, AND PATHS OF DEVELOPMENT AMONG NEW WORLD ECONOMIES, NBER WP

Factor endowments and inequality

- ◆ Most of the New World economies developed extremely unequal distributions of wealth, and they maintained them after independence.
- ◆ The United States and Canada are exceptional in that right from the beginning, they were characterized by relative equality. It may not be coincidental that they began to industrialize much earlier ...

A model of conflict

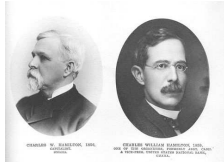
- Two types of wealth: land and capital
- ◆ land is less complementary to human capital than physical capital
 - ◆ Conflict of interest:
 - land-owners want cheap unskilled labor,
 - capitalists want more educated persons.

Galor, Moav and Vollrath: *Divergence and Overtaking: Land Abundance as a Hurdle for Education Reforms*

Conflicts between land-owners and capitalists



Dudley Foster (1730-95), Quaker merchant and Port Commissioner (1785-58) whose first investments were in slaving.



- ♦ The outcome of this conflict - and the support to education - depends on the distribution of wealth

♦ Facts

- Total income growth
- The demographic transition
- Mortality
- Forerunners of fertility control
- Literacy - education - cities

♦ Explanations

- Technical progress
- Right institutions
- Population threshold
- Early mortality decline

♦ Forecasts

Density of population

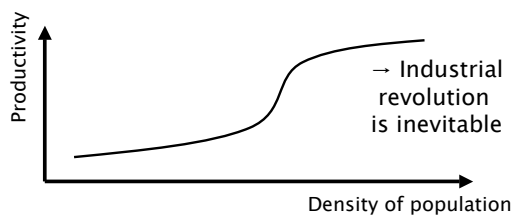
- ♦ Density of population increases
- ♦ Bad in a Malthusian world, but ...
 - Bigger cities - accumulation of human capital + more exchanges of ideas
 - Greater specialization of tasks - increase the productivity
- Speeds up the accumulation of knowledge

« population-induced » technical progress

- ♦ For Galor and Weil, there is a « population-induced » technical progress.
- ♦ If population raises above a given threshold, productivity starts to grow and the transition starts.

« population-induced » technical progress

- ♦ Higher population favors the transmission of knowledge



Lagerlof - stochastic version

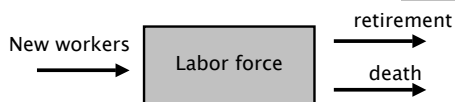
- ♦ There are epidemic shocks
- ♦ Severeness of epidemics falls with human capital (medical skills).
- ♦ If an economy is spared from epidemics long enough, population grows and the economy escapes from stagnation.
- Industrial revolution is inevitable but its timing is random.

- ◆ Facts
 - Total income growth
 - The demographic transition
 - Mortality
 - Forerunners of fertility control
 - Literacy - education - cities
- ◆ Explanations
 - Technical progress
 - Right institutions
 - Population threshold
 - Early mortality decline
- ◆ Forecasts

Effects of longevity on growth

- ◆ We have seen that
 - Early adult mortality decline
 - Improvement in longevity not negligible
 - Comes together with improvements in education
- ◆ What are the theoretical link between longevity and growth ?

The depreciation effect



- ◆ Rising longevity implies lower death rates
 - the depreciation rate of the stock of human capital is lower
 - good for growth

Individual saving effect

- ◆ Individuals expect to live longer,
 - more savings for their old days,
 - funding for investment in physical capital
- good for growth

Education effect

- ◆ When individuals have a longer active life, investment in education is better rewarded, the rate of return on investment in education increases
 - longer schooling

→ good for long-run growth

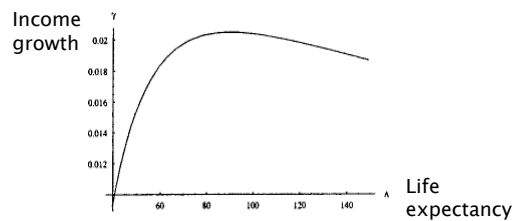
The model - source

- ◆ Model built with Boucekkine and Licandro to study the link:

longevity -> education -> growth

The model

- ◆ The relation between longevity and growth is hump-shaped:



The quantitative effect of longevity

- ◆ Main finding:
 - The observed improvements in early mortality can explain the start of the take-off.
 - Of course not the entire Industrial Revolution
- ◆ Remaining question: why did mortality decline in the first place?
Human factors, immunology, climate ?

To conclude

- ◆ Summary
- ◆ And a question concerning 2000–2100

In a nutshell

- ◆ Escape from the Malthusian trap in the 19th century thanks to higher productivity.
- ◆ Higher returns to human capital, fewer children, more educated.
- ◆ Reasons for the increase in productivity: higher density of population, equal distribution of land, lower adult mortality.
- ◆ The exact weight not clear yet.
- ◆ What does it imply for the future ?

Forecasts

- ◆ Knowing the magnitude of income growth in the 21st century is important:
 - Pension funding
 - Health expenditure
 - Climate change
 - ...

For looking at the future

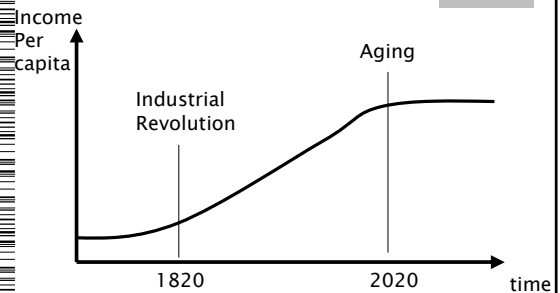
- ◆ For looking at the far distant future, good to look far into the past.
- ◆ What can we tell now for 2000–2100?
- ◆ The two views.

The pessimistic view

- ♦ We have benefitted from a favorable population *structure* during two centuries (cf. demographic transition) which generated the take-off.
- ♦ Now this comes to an end.
- ♦ No more grow after 2020.

Lindh and Malmberg, 2004.

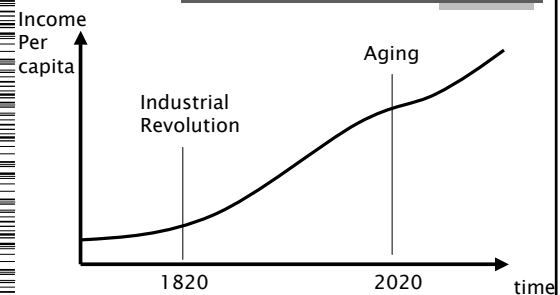
The pessimistic future



The optimistic view

- ♦ Industrial revolution = permanent change of regime, grow will continue.
- ♦ Perhaps slowed down a little by the increased cost linked to aging.

The optimistic future



The end