Longevity and growth in Sweden: 1750-2100

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Facts

- Longevity has increased substantially in the last two centuries:
  - Life expectancy at age 10 = 46 years in 1750
  - It is equal to 70 in 2000
  - Adult life is 24 years longer than in 1750 (not taking into account improvements in infant mortality)

- It is expected to increase even further:
  - Life expectancy at age 10 = 75 in 2050, 78 in 2100
Questions

- Role of longevity in fostering the Industrial Revolution?
- Effect of aging on growth 2000-2100?

Specificity of our view: provide a common approach to both phenomena
Plan of the talk

- Theoretical links between longevity and growth: what are the implications of a rise in longevity?
- A quantitative model for Sweden
Theory – depreciation effect

- Total labor force = past labor force + entry of new workers - exit of retired workers - death of some workers

- Rising longevity implies lower death rates → the depreciation rate of the « stock of workers » is lower → the depreciation rate of the stock of human capital is lower → good for growth
Theory – individual saving effect

- Individuals expect to live longer,
  - more savings for their old days,
  - funding for investment in physical capital
  - good for growth
Theory – individual education effect

- Individuals are more likely to stay alive during their active life,

  investment in education is better rewarded,

  the rate of return on investment in education increases

  → longer schooling

  → good for long-run growth
Theory – age structure effects

- Higher longevity changes the age structure of the population (at constant fertility)
  - The activity rate is affected + or – (depends who benefits the most from longevity)
- Also affect the age structure of the labor force: more old workers
Theory – other effects

- Weight of experience relative to education increases in the economy
  → higher education premium, lower experience premium

- Fiscal effects: Pay-as-you-go pensions are more difficult to sustain
  → need for higher taxes
Theory – indirect effect - density of population

- Density of population increases
  - Bigger cities – speeds up the accumulation of human capital
    + more exchanges of ideas
  - Greater specialization of tasks – increase the productivity
For theory, total effect is indeterminate.

This is why quantitative evaluations are important.

Here, the quantitative exercise covers a period longer than usual: 1750-2100.
Our experiment
The model - source

- Model built with R. Boucekkine and O. Licandro to study the effects of demographics on growth.
The model

- A model where the relation between longevity and growth is hump-shaped:
The model – effect of longevity

- Higher longevity
  - increases schooling
  - fosters growth for low levels of longevity
  - Hampers growth for high levels of longevity

- Negative effect: old workers are less productive (they have obsolete skills)
The model – survival law

- Demographics in the model
  - Concave survival function:

![Graph of survival law with the label FIG. 2. Survival law.](image)
The model – survival law

- The survival function shifts exogenously over time:

![Graph showing changes in survival laws](image)

**FIG. 3.** Changes in the survival laws.
The model – fertility

- Fertility is exogenous but not constant
  - Size of every new generations changes exogenously over time

  → effects through the age structure

- The model abstracts from children (infant mortality)
Additional effect – population density

- higher population density improves the efficiency of education:
Experiment

- Feed into the model actual demographics: Sweden, 1750-2100

- Output:
  - length of schooling
  - Growth of GDP per capita
Data sources

- **Statistics Sweden**
  - Population development in Sweden in a 250-year perspective, Demografiska rapporter 1999:2, Table 1.2, "Population by sex and age 1750-1998"

- Extrapolation of official forecast by Bo Malmberg
Life expectancy at age 10
Size of the newborn cohort
Retirement age

- We assume a constant effective retirement age of 63
Results
Output - Years of schooling after age 10

Years of schooling after age 10:

- 1700: 5.4
- 1800: 5.6
- 1900: 5.8
- 2000: 6.0
- 2100: 6.2
Schooling

- Higher longevity explains part of the rise in schooling
  → need for another mechanism on top of longevity

- No big gains beyond 2000
Growth of income per capita goes from 0.1% in 1750 to 1.63% in 1900, 1.81% in 1960 (maximum), 1.76% in 2000, 1.58% in 2050, and 1.37% in 2100.
Sensitivity analysis

What if longevity stays constant after 2000?
Growth with constant longevity

- Growth rate over time from 1800 to 2100, showing periods of growth and decline.
Sensitivity analysis

- With constant longevity after 2000, annual growth rates are
  - 1.55% in 2050
  - 1.50% in 2100
- Instead of
  - 1.58% in 2050
  - 1.37% in 2100
In the baseline simulation

Remark the delay in the materialization of the effect

→ Further improvements in longevity are bad for growth (but probably good for welfare?)
What if fertility increases after 2000?

We run a simulation with a constant size of the newborn cohort, equal to the 2000 level.
Size of the new generation
Growth with higher fertility
Sensitivity analysis -2

- With higher fertility, annual growth rates are
  - 1.58% in 2050
  - 1.41% in 2100
- Instead of
  - 1.58% in 2050
  - 1.37% in 2100
In the baseline simulation

→ very little effect
Conclusion

- Effect of demographics on growth: global analysis from the take-off in 1800 to the ageing in 2000 through the demographic transition
- Rising longevity can account for part of the rise in schooling
Conclusion - 2

- Assuming that density of population matters for growth, we can fully account for the take-off: longevity effect + density effect
- But too high longevity can be bad for growth:
  - Growth has peaked around 1960
  - Growth will lose 0.5% over the 21st century