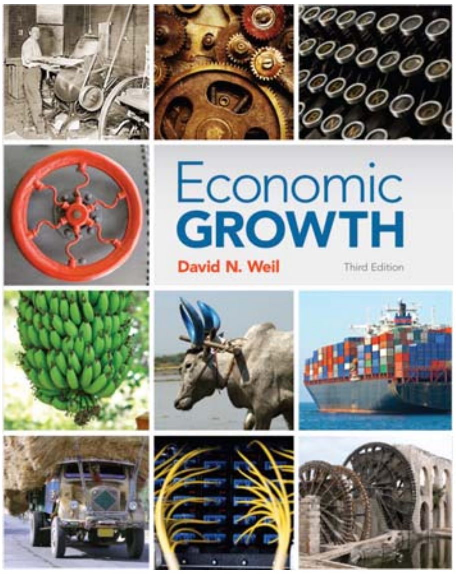
Chapter 4

POPULATION AND ECONOMIC GROWTH



Groups for presentations

1. …
2. …
3. …
4. …
5. …

European Commission > ··· > Economic and fiscal policy coordination > EU Economic governance: monitoring, prevention, correction >

The European Semester

The European Semester provides a framework for the coordination of economic policies across the European Union. It allows EU countries to discuss their economic and budget plans and monitor progress at specific times throughout the year.

The framework

The European Semester: why and how
Macroeconomic imbalance procedure
Stability and Growth Pact

European Semester timeline

Setting the priorities
The analysis phase
National Reform Programmes and Stability/Convergence Programmes
EU country-specific recommendations
Putting recommendations into practice

Thematic factsheets

Business environment
Financial stability
Green economy
Public administration
Labour markets and skills
Social protection and cohesion
Fiscal stability

The European Semester in your country

Austria

Themes for presentations

1. …
2. …
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Calendar

1. …
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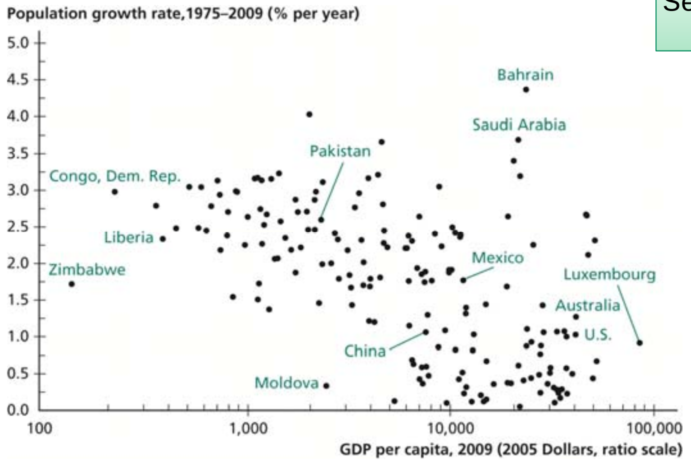
Relationship Between Income per Capita and Population Growth

See Gapminder

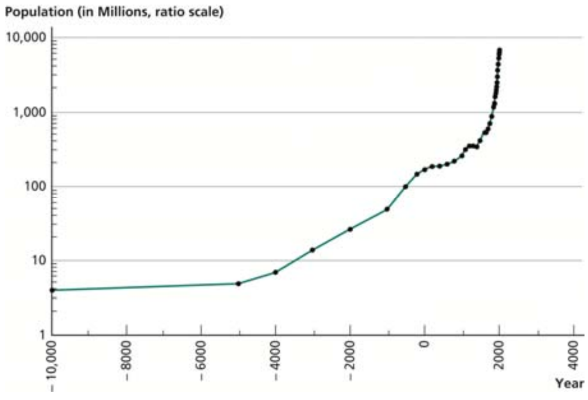


ALWAYS LEARNING PEARSON

Population growth

- High population growth → low income?
  - ....
- High income → low population growth?
  - ...
- Omitted variables that affect both income and population growth?

World Population, from 10,000 B.C. to A.D. 2010



Source: Kremer (1993).

World Population : 10,000 BC to 2010 AD

High population growth only in recent decades.

Growth rates over time:

- 10,000 BC-0: 0.04%
- 0-1800: 0.09%
- 1800-1900: 0.6%
- 1900-1950: 0.9%
- 1950-2000: 1.8%

14th Oct 2018

Current World Population

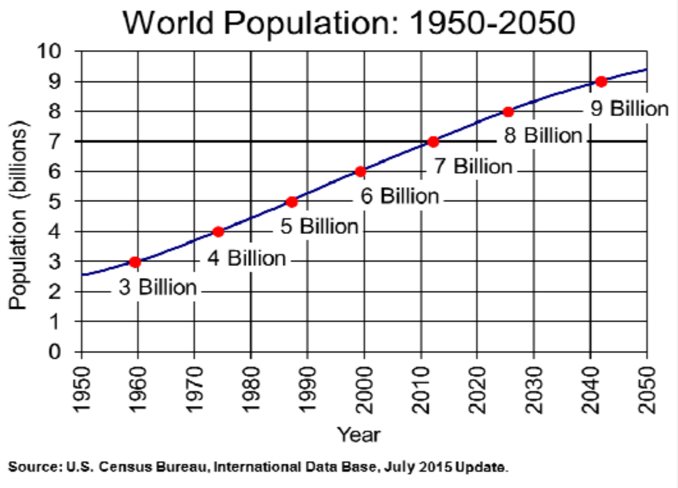
7,656,635,743

view all people on 1 page >

TODAY	THIS YEAR
Births today **269,524**	Births this year **110,605,151**
Deaths today **111,635**	Deaths this year **45,811,803**
Population Growth today **157,889**	Population Growth this year **64,793,348**

World Population : 1950 to 2050

Increase from 3 billion in 1959 to 6 billion by 1999. Projections: From 6 in 1999 to 9 by 2042, a 50% increase that is expected to require 43 years.



Malthus' theory

Thomas Malthus (1766-1834):

Essay on the Principle of Population (1798).

The first economist to propose a systematic theory of population.

Central idea: Population growth is determined by the economic environment.

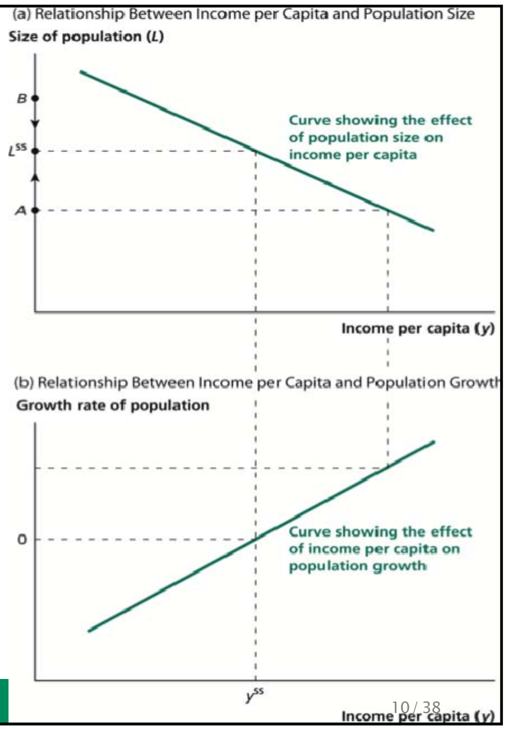
Malthus' theory

- Assumptions:
  1. Large population → Low income per capita.
     - Because of finite quantity of resources (land, food).
  2. Low income per capita → low fertility /high mortality
     → population size ↓
     - Feedback loop from 2. to 1.
- Population limited by
  - famine and disease → Malthusian catastrophe (positive check)
  - deliberate reduction in fertility to prevent poverty (preventive check).

  - No role for improvement in living standards.

Malthus' theory

$y > y^{ss}$ −→ population growth −→ y ↓.
$y < y^{ss}$ −→ population falls −→ y ↑.

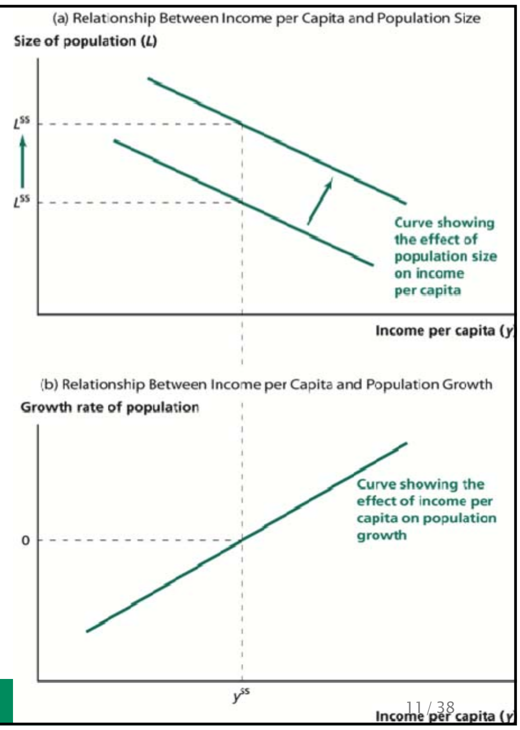


Productivity improvement

More resources −→ higher y −→
Population growth −→ y ↓.

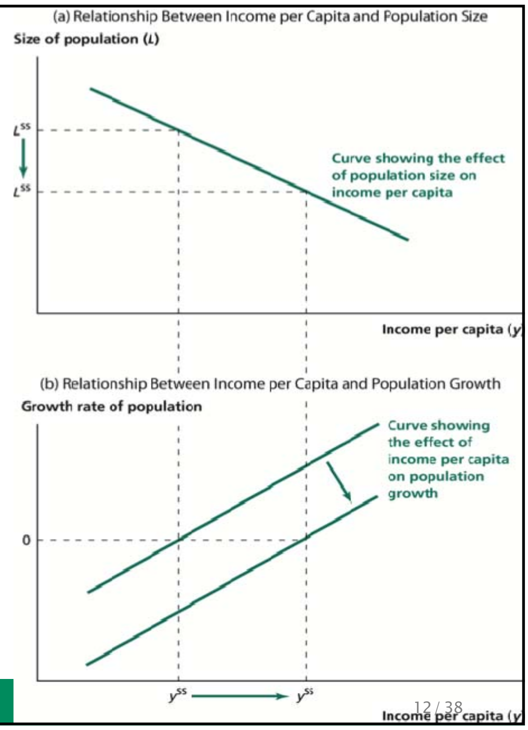
Hence no improvement in living standards, only population growth.

Consistent with the data until early 1800s.



Moral restraint

Only lower fertility will increase GDP/capita.



Last two centuries

Predictions from theory:

GDP/capita constant in the long run.

More food, land etc available (productivity growth) → population growth.

Data:

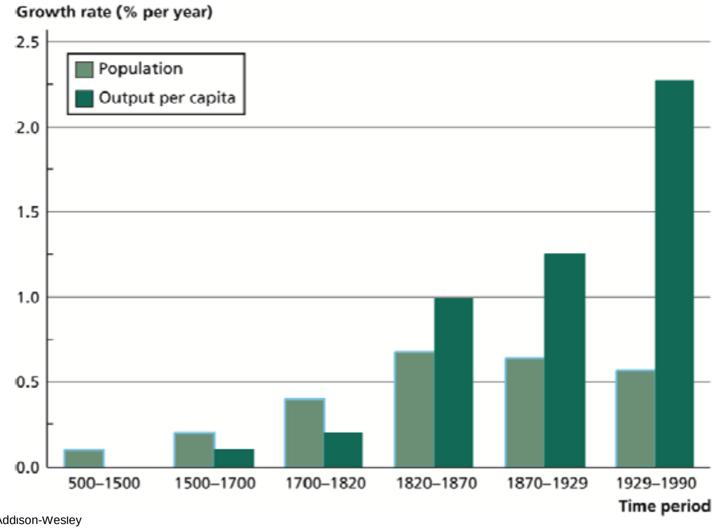
Enormous productivity improvements, followed by

- Low population growth in rich countries
- Increase in living standards.

Breakdown of the Malthusian model

Malthus predicts high population growth when output ↑.

No longer valid today, population growth negative in many rich countries.



What's wrong with Malthus' model?

Resources (capital, land, crops etc) are fixed.

- Resource limitations such as land less important today.
- Human capital and ideas can be shared irrespective of population size.

Assumptions about population growth.

Does population size not matter for living standards anymore?

Fixed factors still exist:

- Food.
- Environment (e.g., global warming).
- More?

The Solow model revisited

- Let's introduce population growth n in the Solow model.
- Is high n bad for growth (per capita)?
- Yes.
  - Intuition: High n means that the capital/worker ratio ↓.
  - This dampens the steady state growth rate.

Define $\frac{\partial L}{\partial t} = \dot{L}$ $\quad n = \frac{\dot{L}}{L}$

Change in the capital stock: $\dot{K} = \gamma Y - \delta K$.

Change in capital stock

Let's rewrite $\dot{K}$ in intensive form:

$$\dot{k} = \frac{\partial (K/L)}{\partial t} = \frac{\dot{K}L - K\dot{L}}{L^2}$$

$$= \frac{\dot{K}}{L} - \frac{K}{L}\frac{\dot{L}}{L}$$

$$= \frac{\gamma Y - \delta K}{L} - kn$$

$$= \gamma f(k) - (\delta + n)k.$$

Steady state

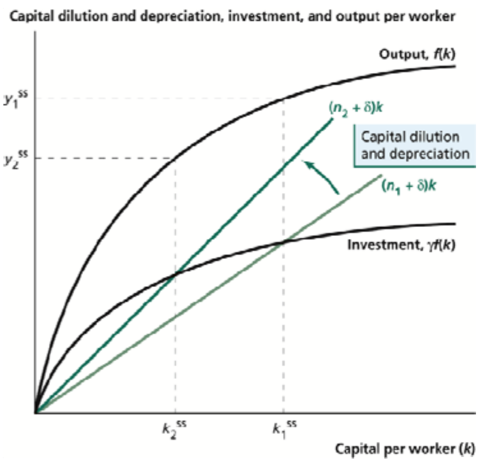
Steady state defined by $\dot{k} = 0$:

$$\gamma f(k) - (\delta + n)k = 0$$

$$\gamma f(k) = (\delta + n)k.$$

Investment per worker (LHS) = depreciation + dilution of capital per worker (RHS).

Steady state



Higher $n \longrightarrow$ Steeper slope of $(n+\delta)\,k \longrightarrow$ SS $k\downarrow$ and $y\ \downarrow$.
Intuition: Less capital/worker $\longrightarrow$ lower productivity.
Growth in y or Y? In Y but not y.

The Cobb Douglas case

Let $f(k) = Ak^{\alpha}$. Then the SS equation becomes

$$\gamma A k^{\alpha} = (n+\delta)k$$

$$k^{\alpha-1} = \frac{n+\delta}{\gamma A}$$

$$k^{ss} = \left(\frac{\gamma A}{n+\delta}\right)^{1/(1-\alpha)}.$$

Insert k^{ss} into the production function:

$$y^{ss} = Ak^{\alpha} = A^{1/(1-\alpha)}\left(\frac{\gamma}{n+\delta}\right)^{\alpha/(1-\alpha)}$$

The Cobb Douglas case

Assume two countries i and j, with same A's and γ's but $n_i > n_j$. Then

$$\frac{y_i^{ss}}{y_j^{ss}} = \left(\frac{n_j + \delta}{n_i + \delta} \right)^{\alpha/(1-\alpha)} < 1.$$

E.g. if $\alpha = 1/3$, $\delta = 0.05$, $n_i = 0.04$ and $n_j = 0$. Then

$$\frac{y_i^{ss}}{y_j^{ss}} = 0.75.$$

Malthus vs Solow

Both models can explain negative correlation between population growth & income. But mechanism differs:

Population vs land (Malthus) vs Population vs capital (Solow) Endogenous population (Malthus) vs exogenous population (Solow).

Explaining population growth

Models suggest that population growth matters for living standards. But what determines population growth?

Level of development.

- **The demographic transition**: Development/growth leads to a transformation of demographic characteristics.

In particular:

- Mortality transition.
- Fertility transition.

Life Expectancy

Define life expectancy at time of birth

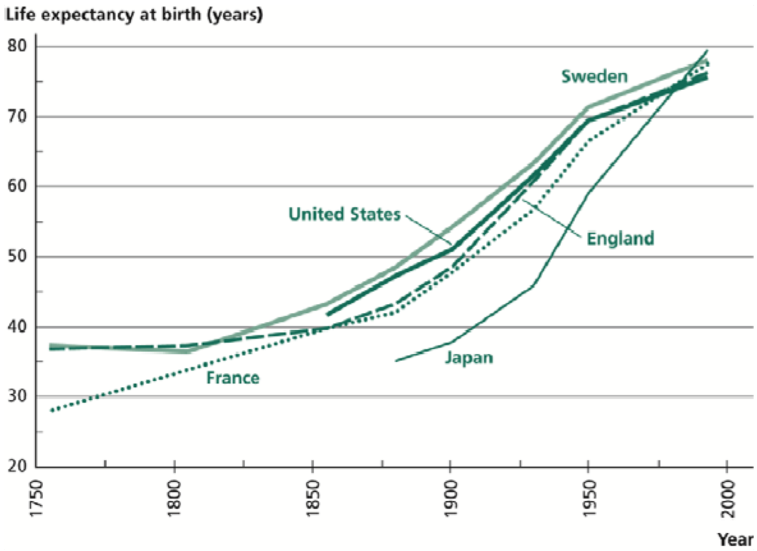
$$\sum_{i=0}^{T} \pi(i),$$

where $\pi(i)$ is the probability that a person will be alive at age i

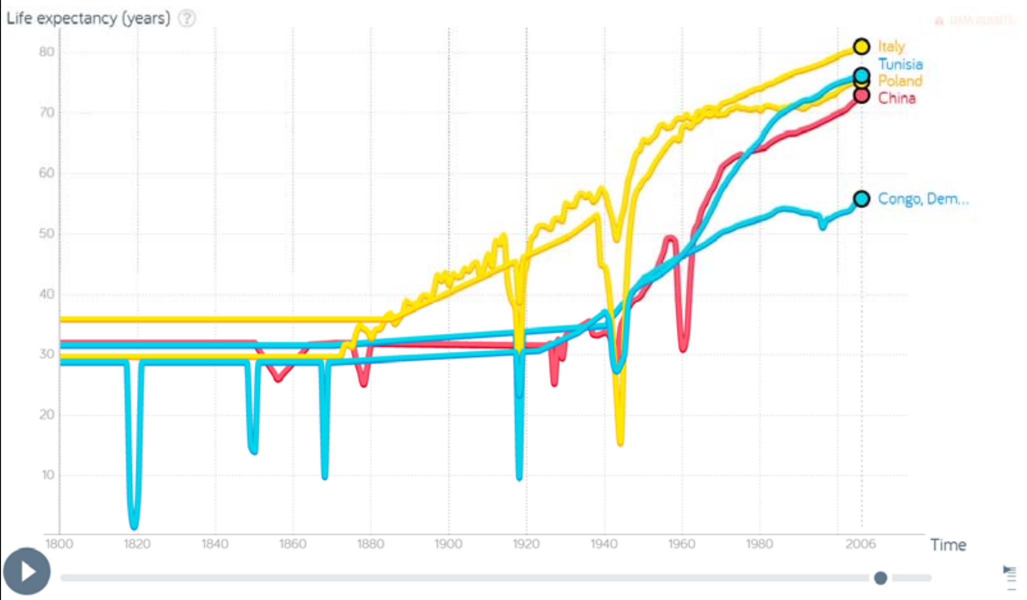
. Small/no change in life expectancy before the 1700s.

Dramatic increase the last 200 years.

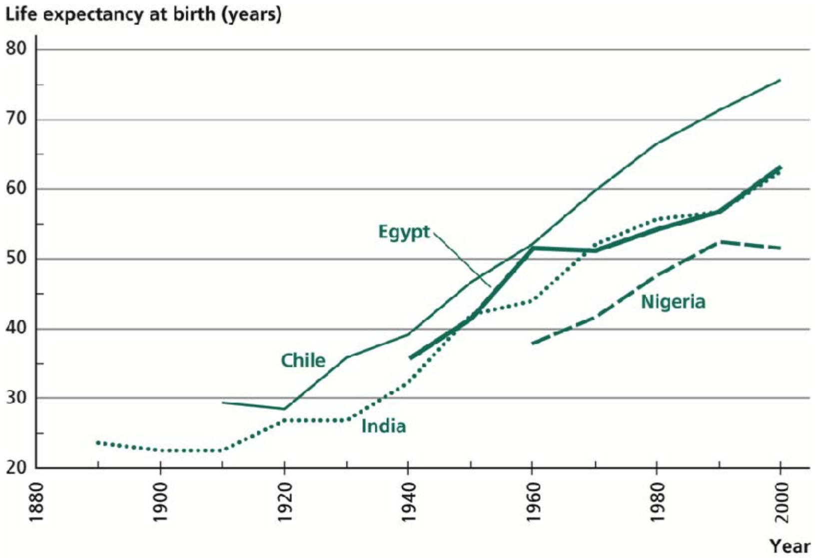
Life Expectancy



Life Expectancy : Italy & c



Mortality : Developing countries



Explaining mortality transition

- Better living conditions (nutrition, housing).
- Public health (water and sewage).
- Medical treatments.

Explaining mortality transition

Better living conditions (nutrition, housing).
Public health (water and sewage).
Medical treatments.

Infant mortality.

Fertility

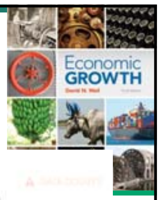
Define total fertility rate (TFR) as expected number of children that a woman would have if she lived through all of her childbearing years:

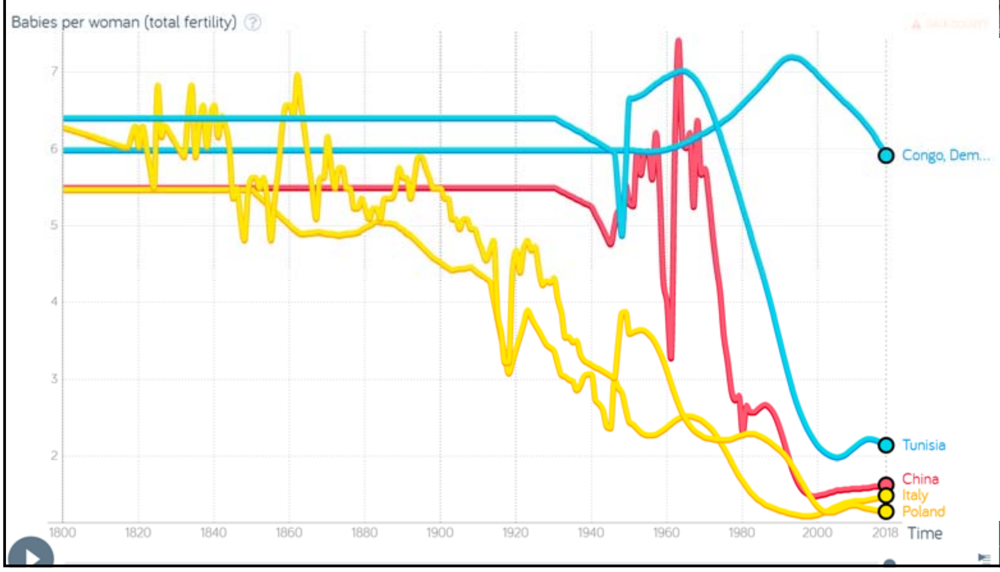
$$TFR = \sum_{i=0}^{T} F(i)$$

where $F(i)$ is the age-specific fertility rate (average no of children for woman of age i).

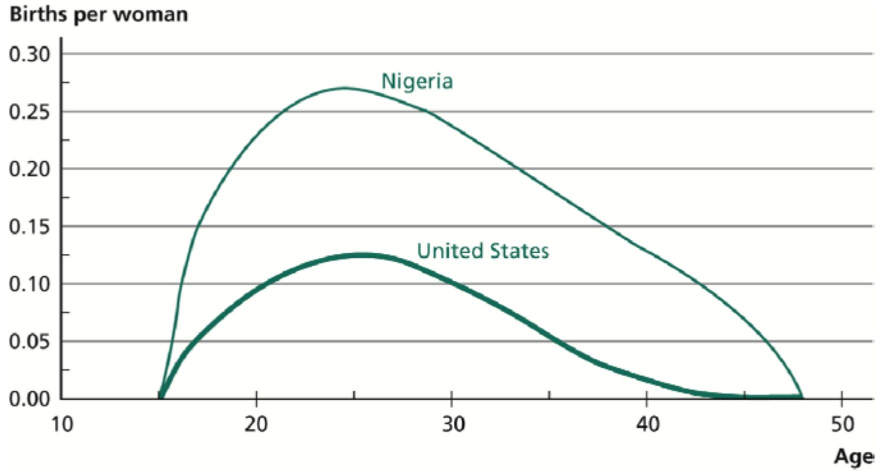
US Fertility, 1860-2008

Some countries' fertility, 1860-2008





Age-specific fertility, 1999

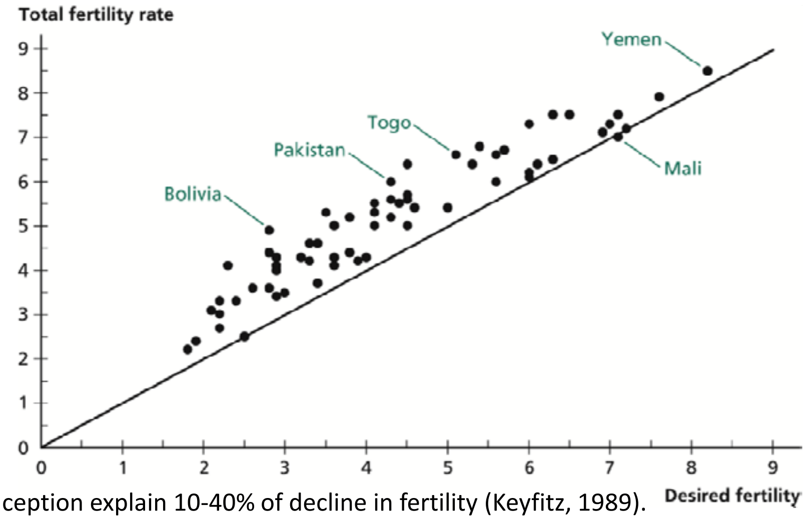


TFR = area under the curve, 2.1 for U.S., 6.0 for Nigeria.

Explaining fertility transition

- Improved technology (contraception).
  - Contraceptive pill (1960-)
  - Quality condoms (1840s-).
- Family planning attitudes & programs.
  - One-child policies.

Desired and actual fertility, 70s and 80s



Contraception explain 10-40% of decline in fertility (Keyfitz, 1989).
Attitudes more important.

Explaining fertility transition

Development. U.N. (1974): "Development is the best contraceptive". Mortality reduction −→ lower fertility bc # *surviving* children matters. Income and substitution effects.

- Income effect: Get more children.
- Substitution effect: Get less children because the *opportunity cost* is higher.
- Opportunity cost even higher if women become more educated and earn more.

Resource flows between parents and children.

- Decline of child labor
- Social Security.
- Quality-quantity trade-offs.
- More investment in quality of child vs quantity.
- Because of higher life expectancy?

Fertility-mortality interaction

Define net rate of reproduction (NRR) as the number of daughters that each girl who is born can be expected to give birth to.

Assuming fertility and mortality rate of current population:

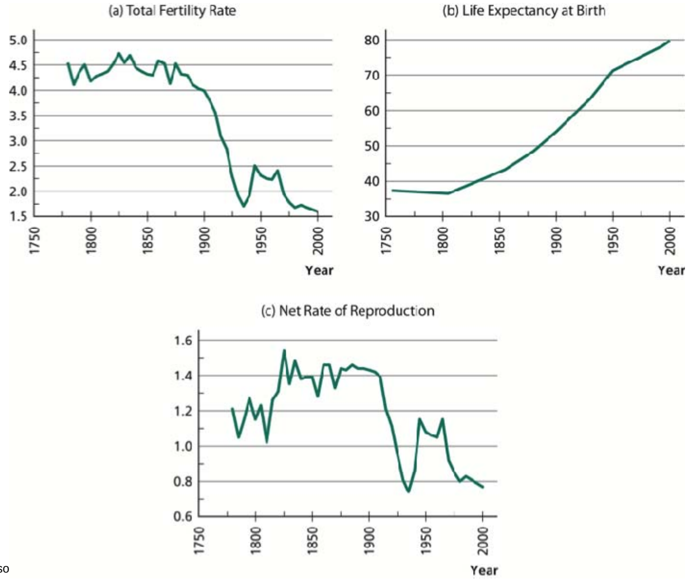
$$NRR = \beta \sum_{i=0}^{T} \pi(i)F(i)$$

where β is the share of female newborns.

Zero population growth if NRR = 1.

Example: Sweden

Demographic transition complete: Both fertility and mortality down, currently *NRR* < 1.



Example: Nigeria

Period	Total Fertility Rate	Life Expectancy at Birth	Net Rate of Reproduction
1955–1960	6.90	38.2	1.97
1965–1970	6.90	42.0	2.12
1975–1980	6.90	46.1	2.28
1985–1990	6.70	50.2	2.38
1995–2000	5.92	52.5	2.20
2000-2005	5.61	50.3	2.00

Source: United Nations Population Division (2010).

End of demographic transition?

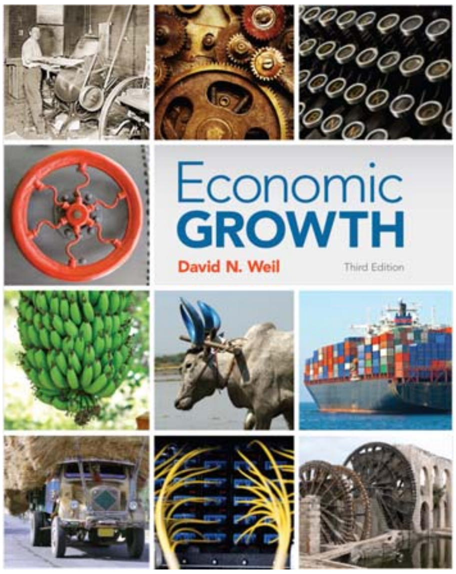
Example: India

Period	Total Fertility Rate	Life Expectancy at Birth	Net Rate of Reproduction
1955–1960	5.92	42.6	1.75
1965–1970	5.69	48.0	1.67
1975–1980	4.83	52.9	1.73
1985–1990	4.15	57.4	1.61
1995–2000	3.45	62.1	1.43
2000-2005	2.73	64.2	1.17

Source: United Nations Population Division (2010).

Chapter 6

HUMAN CAPITAL



Human capital and income

So far: Workers assumed to be identical over time and across countries.

How can differences in **human capital** explain cross-country income differences?

Human capital: Factors that influence the productivity of the worker, e.g. education & health.

Production function with human capital:

$$Y = F(K, hL) ,$$

where h is effort/quality per worker.

Human capital as an input

- We focus on qualities of people who are productive
- We concentrate on qualities which are produced, as with phisical capital also human capital is itself produced, contrary to natural resources
- Human capital earns returns, e.g. investment in education increases the wage.
- Cannot be rented, as opposed to physical capital, that is workers have to work to get it whilst capital owners can relax on a beach)
- Human capital depreciates
- Human capital can have two forms: health and education

Human capital: Health

We'll focus on two determinants of human capital: Health & education.

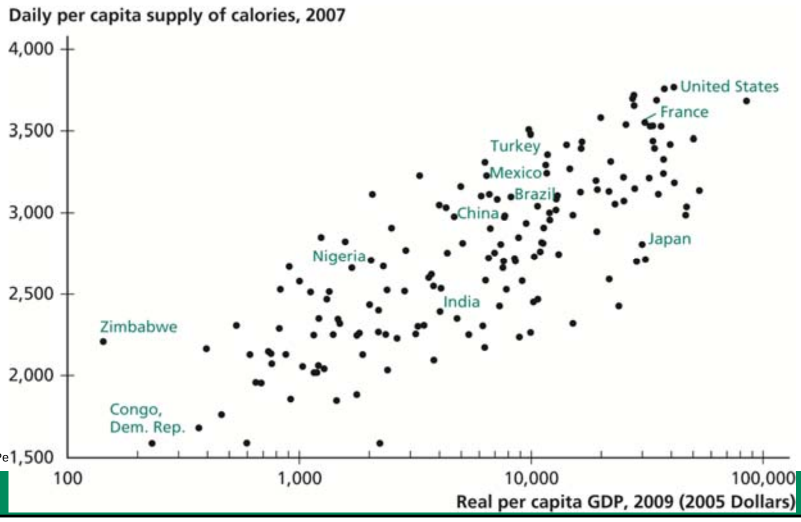
Better health:

Improves productivity - increase output by working more or improving quality.

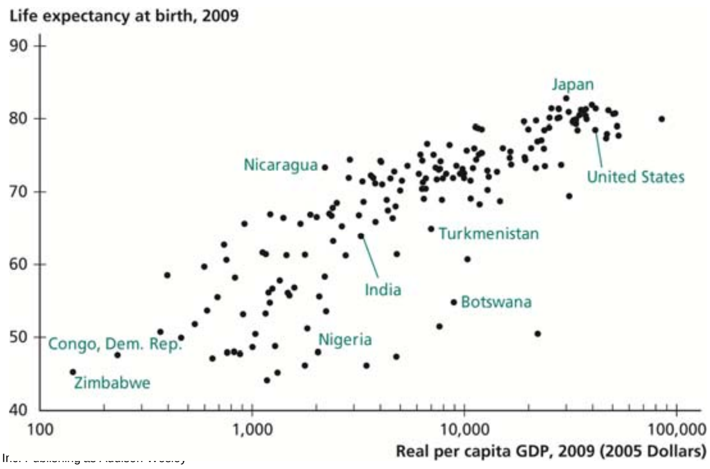
Brings more people into the workforce.

Human capital as a form of health

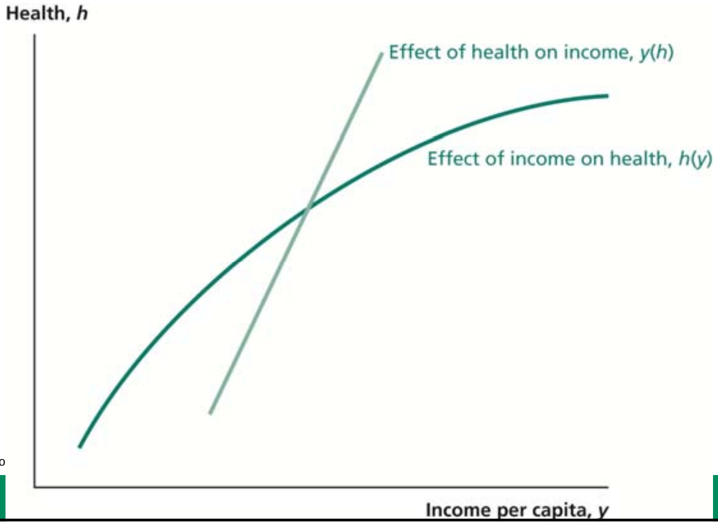
Nutrition versus GDP per Capita



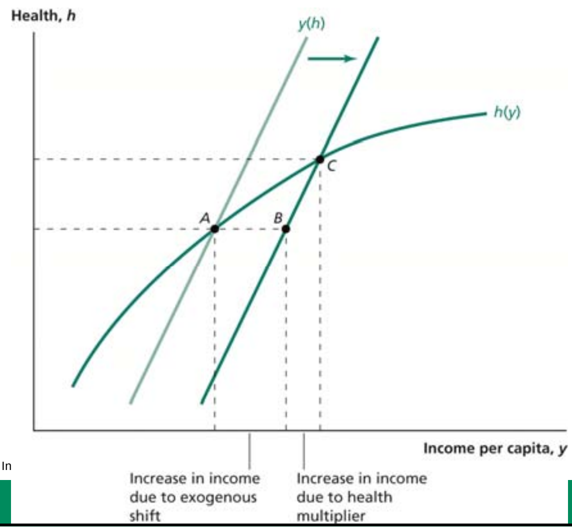
Life Expectancy versus GDP per Capita



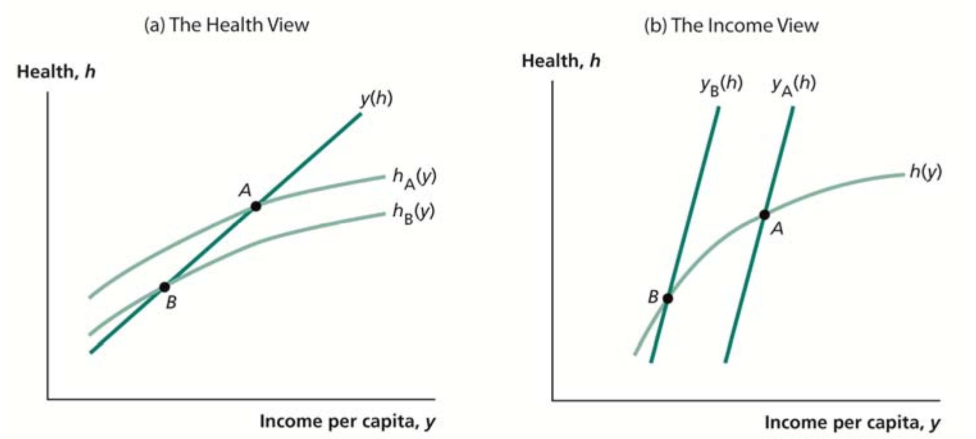
How Health Interacts with Income



Effect of an Exogenous Shift in Income



Health and Income per Capita: Two Views



HC : Education

Education & skills also human capital.

- Boost productivity & wages
- Intrinsic value, higher utility.

Human capital in the form of education
Changes in the Level of Education, 1975-2010

				Percentage of the Adult Population with			
		Average Years of Schooling	No Schooling	Complete Primary Education	Complete Secondary Education	Complete Higher Education
Developing Countries	1975	3.2	47.4	32.9	8.1	1.6
	2010	6.7	20.8	68.8	31.5	5.3
Advanced Countries	1975	8.0	6.2	78.8	34.9	8.0
	2010	11.0	2.5	94.0	63.9	16.6
United States	1975	11.4	1.3	94.1	71.1	16.1
	2010	12.4	0.4	98.8	85.4	20.0

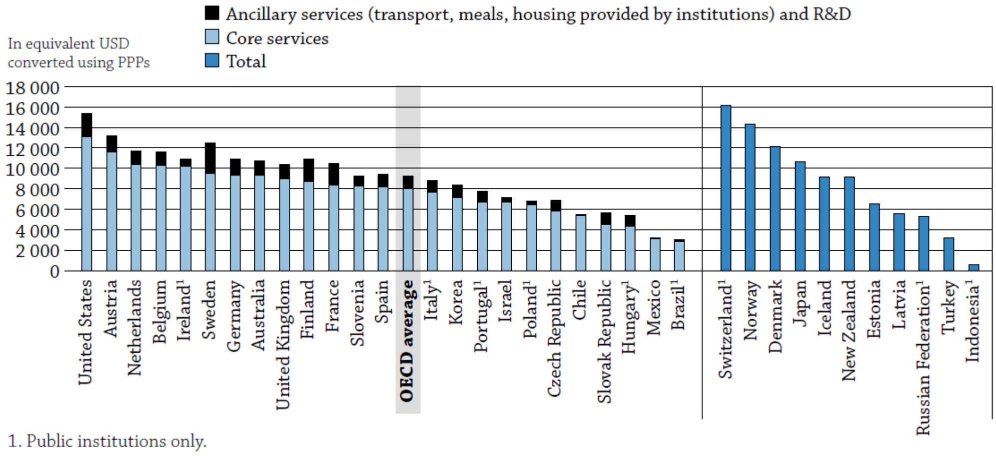
Source: Barro and Lee (2010). Data for population 25+.

Education as an investment

- It is costly (6% of GDP in US, 4.5% in Italy)
- Not only in terms of money but especially in terms of opportunity costs (this is true mostly for developing countries)
- The return to education is wage…a wage premium

Chart B1.1. Annual expenditure per student by educational institutions, by type of service (2011)

In equivalent USD converted using PPPs, based on full-time equivalents, for primary through tertiary education

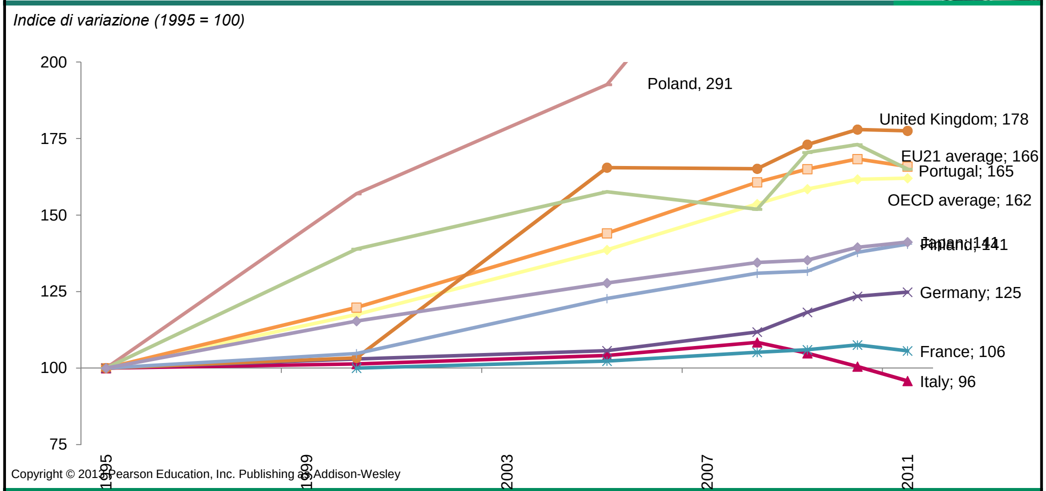


1. Public institutions only.

Countries are ranked in descending order of expenditure per student by educational institutions for core services.

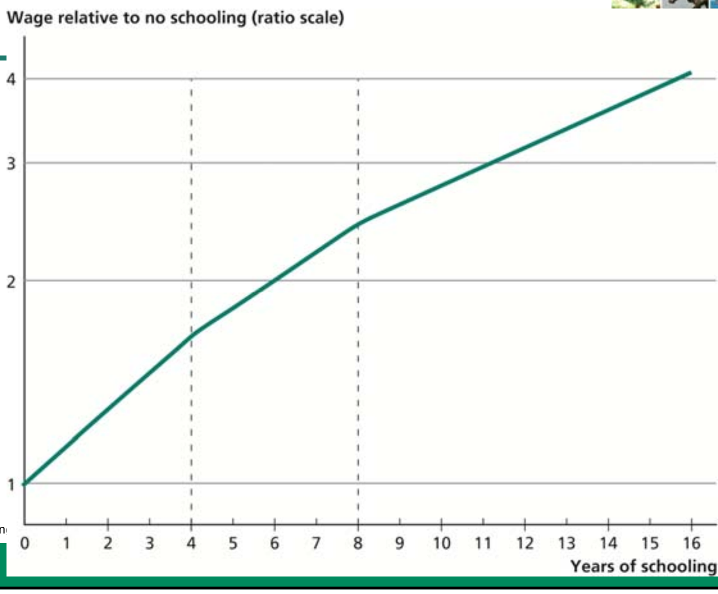
Change in per student expenditure total, constant prices(1995 = 100)

Table B1.5a



Effect of Education on Wages

Hall and Jones (1999). 13.4% per year for years 1-4, 10.1% for next 4 years, 6.8% for 8+ year.

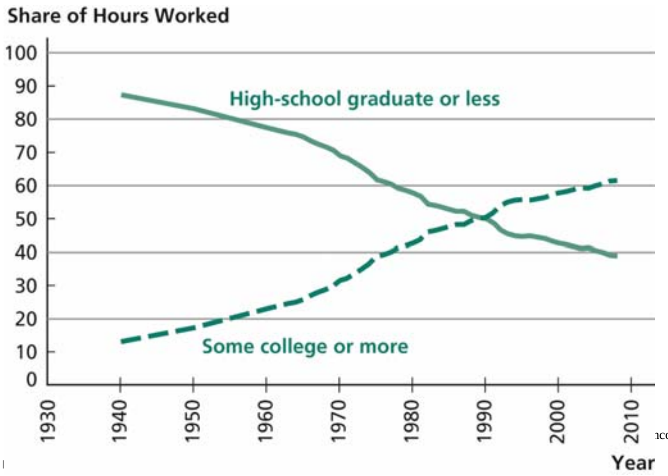


Decomposing wages

We know that capital's share of income is around 1/3 (the α).

For the remaining 2/3, how much is due to human capital and how much is "raw labor".

Share of Hours Worked by Education Level, 1940–2008



ıcoming).

Share of HC in wages

Highest Level of Education	Years of schooling	Wage Relative to No Schooling	Percentage of the Population: Developing Countries	Percentage of the Population: Advanced Countries
No Schooling	0	1.00	20.6	2.5
Incomplete Primary	4	1.65	10.4	3.4
Complete Primary	8	2.43	18.0	12.3
Incomplete Secondary	10	2.77	19.3	17.8
Complete Secondary	12	3.19	23.2	37.4
Incomplete Higher	14	3.61	2.9	8.9
Complete Higher	16	4.11	6.3	18.6

Source: Barro and Lee (2010).

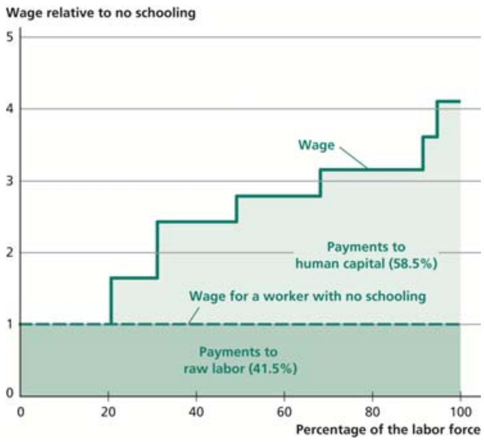
Raw labor is 1/4 of wages.

For the economy as a whole, the HC share is larger in advanced countries.

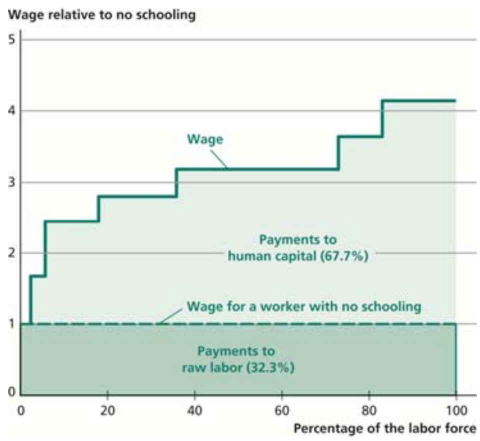
- Higher wages for more education.
- Larger share of population with more education.

Share of Human Capital in Wages in Developing Countries

Remember alpha in the Solow model



Share of Human Capital in Wages in Advanced Countries



Education and Income

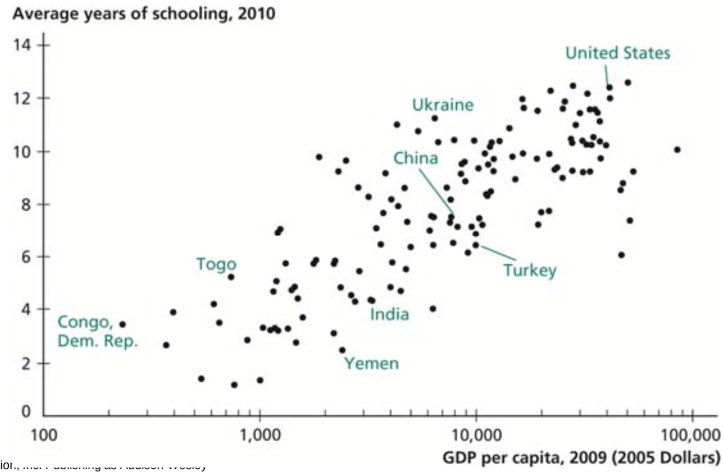


Table A7.3a. **Private costs and benefits for a man attaining tertiary education (2010)**

As compared with a man attaining upper secondary or post-secondary non-tertiary education, in equivalent USD converted using PPPs for GDP

	Year	Direct costs (1)	Foregone earnings (2)	Total costs (3)	Gross earnings benefits (4)	Income tax effect (5)	Social contribution effect (6)	Transfers effect (7)	Unemployment effect (8)	Grants effect (9)	Total benefits (10)	Net present value (11)	Internal rate of return (12)
OECD Netherlands	2010	-14 646	-95 834	**-110 480**	442 661	-197 999	-26 901	0	10 736	13 770	**242 267**	**131 787**	7.2%
New Zealand	2010	-9 384	-43 347	**-52 731**	193 910	-62 325	-3 875	-86	358	3 039	**131 021**	**78 290**	7.3%
Norway	2010	-1 086	-47 946	**-49 032**	274 357	-107 528	-23 197	0	23 000	4 690	**171 321**	**122 289**	8.2%
Poland	2010	-7 343	-16 928	**-24 270**	376 155	-30 873	-75 986	0	38 492	2 228	**310 015**	**285 745**	24.6%
Portugal	2010	-4 627	-16 181	**-20 808**	324 887	-89 461	-36 243	0	17 564	m	**216 746**	**195 937**	18.3%
Slovak Republic	2010	-6 183	-15 019	**-21 202**	290 121	-51 866	-40 961	0	38 465	1 226	**236 985**	**215 783**	21.4%
Slovenia	2010	-3 564	-26 242	**-29 806**	447 946	-110 866	-96 037	0	19 992	259	**261 294**	**231 488**	17.1%
Spain	2010	-8 864	-28 219	**-37 083**	178 900	-52 903	-14 033	0	41 874	3 791	**157 629**	**120 546**	11.2%
Sweden	2010	-3 560	-50 291	**-53 851**	209 467	-84 430	-9 281	0	8 454	7 735	**131 945**	**78 094**	7.4%
Switzerland		m	m	**m**	m	m	m	m	m	m	**m**	**m**	m
Turkey	2005	-1 061	-9 402	**-10 463**	106 985	-18 682	-16 424	0	2 761	m	**74 640**	**64 177**	19.3%
United Kingdom	2010	-20 162	-47 655	**-67 817**	413 163	-89 124	-49 107	-4 303	40 284	5 225	**316 138**	**248 322**	14.3%
United States	2010	-61 135	-44 678	**-105 813**	628 922	-210 898	-55 768	0	100 046	27 162	**489 463**	**383 649**	15.4%
OECD average		-10 563	-40 755	**-51 318**	347 075	-105 528	-38 085	-777	29 016	6 181	**236 602**	**185 284**	13.9%
EU21 average		-6 258	-41 078	**-47 335**	361 801	-112 936	-45 075	-1 123	31 620	6 135	**239 503**	**192 167**	15.1%
Italy	2008	-7 285	-50 608	**-57 893**	408 011	-159 562	-41 835	0	3 295	3 330	**213 239**	**155 346**	8.1%
Japan	2007	-37 215	-66 750	**-103 965**	326 614	-64 523	-36 039	0	20 931	m	**246 983**	**143 018**	7.4%
Korea	2010	-19 211	-34 019	**-53 231**	379 884	-47 160	-25 602	0	12 407	m	**319 528**	**266 298**	12.8%

Quantitative analysis of the impact of education differences

- In the simple Solow model: $Y=F(K,L) = AK^{\alpha}L^{1-\alpha}$

$y_{ss} = A\, k_{ss}^{\ \alpha} = A^{1/(1-\alpha)}\, (\gamma/\delta)^{\alpha/(1-\alpha)}$

let us add human capital and population dynamics…

- $Y=F(K,L,H) = h^{1-\alpha}AK^{\alpha}L^{1-\alpha}$, where *h* is effort/quality per worker.
- $y_{ss} = (h^{1-\alpha}A)^{1/(1-\alpha)}\, (\gamma/n+\delta)^{\alpha/(1-\alpha)}$
- $y_{ss} = h\, [A^{1/(1-\alpha)}\, (\gamma/n+\delta)^{\alpha/(1-\alpha)}\,]$

Quantitative analysis of the impact of education differences

- In the simple Solow model
- $y^{i}_{ss} / y^{j}_{ss} = (\gamma^{i}/\gamma^{j})^{\alpha/(1-\alpha)}$

- Now with h and n
- $y^{i}_{ss} / y^{j}_{ss} =$

$= h^{i}\, [A^{1/(1-\alpha)}\, (\gamma/n+\delta)^{\alpha/(1-\alpha)}\,] / h^{j}\, [A^{1/(1-\alpha)}\, (\gamma/n+\delta)^{\alpha/(1-\alpha)}\,]$

$= h^{i} / h^{j}$

Predictions

Two countries i and j, with h_i and h_j, all else equal.

Then

$$\frac{y_i^{ss}}{y_j^{ss}} = \frac{h_i}{h_j}$$

Income per capita proportional to HC.
E.g. twice as high h in i yields twice as high y.

A numeric example

- 12 years of schooling in i and 2 in j.
- What is human capital h in the two countries?

  Recall wage increase per year of additional schooling (13.4% for grades 1-4, etc).

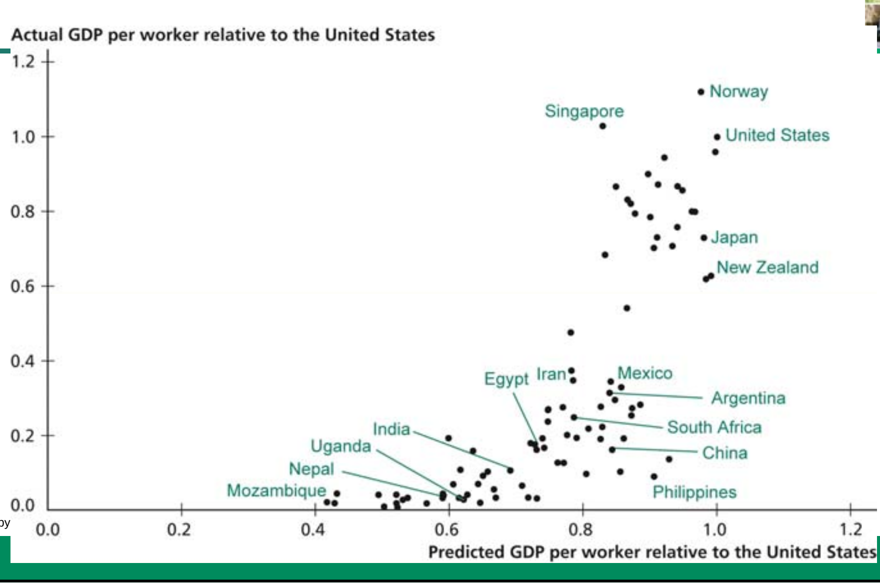
  Assume human capital h proportional to wages.
- Then $h_i = 1.134^4 \times 1.101^4 \times 1.068^4 \times h_0 = 3.16 \times h_0$

$h_j = 1.134^2 \times h_0 = 1.29 \times h_0$

- And

$$\frac{y_i^{ss}}{y_j^{ss}} = \frac{3.16 h_0}{1.29 h_0} = 2.47.$$

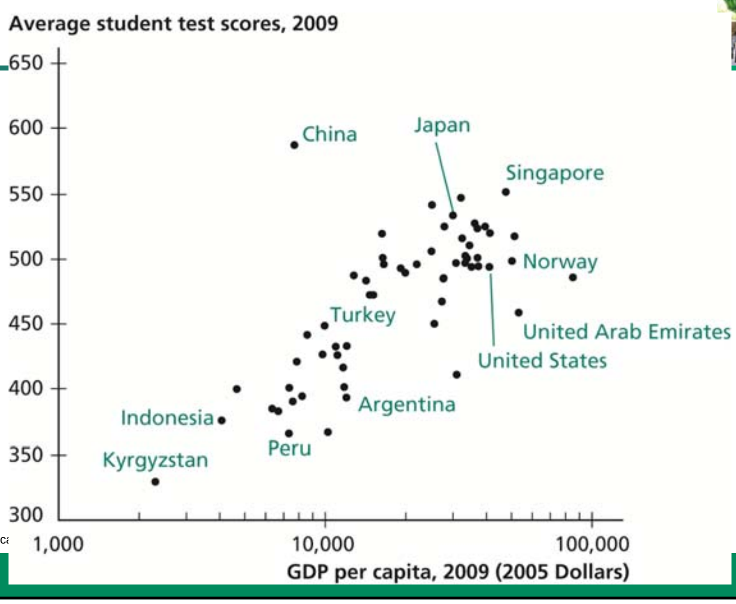
Predicted versus Actual GDP per Worker



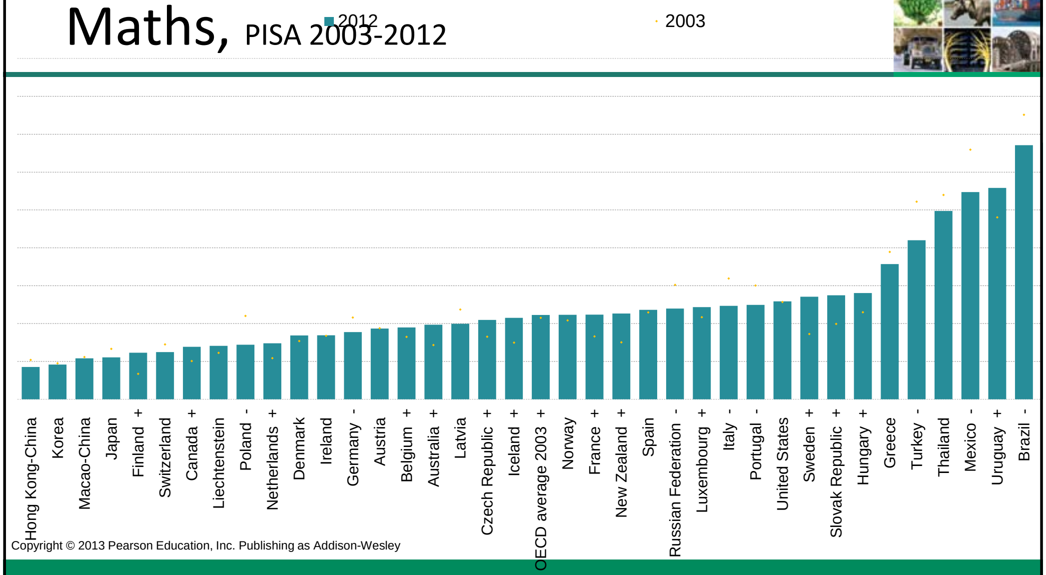
Important factors to explain why predictions are so wrong…

- Quality of schooling
- Externalities

Student Test Scores versus GDP per Capita



Percentage of low performers in Maths, PISA 2003-2012



Externalities

Externalities: An incidental effect of economic activity for which no compensation is provided.

The Solow model could not generate sufficient income inequality coming from human capital.

- One reason could be externalities.

Education: Additional schooling for individual x $\longrightarrow$ private return to x but also returns for y.

- E.g. x adopts new technologies that y also will use.

More on education

- Education at a glance
- Alma laurea