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Join us to complete the survey online ... it takes just 10 minutes!

- £10 Amazon voucher for those who complete the survey by 18 Feb 2019!
- **FREE** chocolate and a drink!
- Enter Economics **prize draw** for an **Apple iPad*** and four £50 vouchers!

Week 17

Tue 12 Feb 11.00-12.00 (SibPC1)

Wed 13 Feb 11.00-12.00 (KSA1)

Fri 15 Feb 15.00-16.00 (KSA1)

Week 20

Mon 4 Mar 13.00-14.00 (KSA1)

Wed 6 Mar 09.30-11.00 (CSPC1)

Wed 6 Mar 11.30-13.00 (KSA1)

Thu 7 Mar 13.00-15.00 (KSA1)

If you've already completed the survey, email your confirmation to economics@kent.ac.uk to enter the prize draw, or come along and join us for a drink!

* The prize draw for an Apple iPad will take place if the School of Economics reaches its 80% student completion target.

EC569 Economic Growth Human Capital (Lecture 5)

İlhan Güner
School of Economics, University of Kent

February 11, 2019

Introduction

- So far, we have treated labor as constant across countries and over time.
- Quality of labor a worker supplies depends on whether a worker is
 - weak or strong
 - ill or healthy
 - ignorant or educated

Human Capital

Human capital: Qualities of labor that

- are productive (characteristics that enable workers to produce more),
- are produced (investment in human capital),
- earns a return (higher wage for owners of human capital),
- depreciates.

Impact of Human Capital on Income

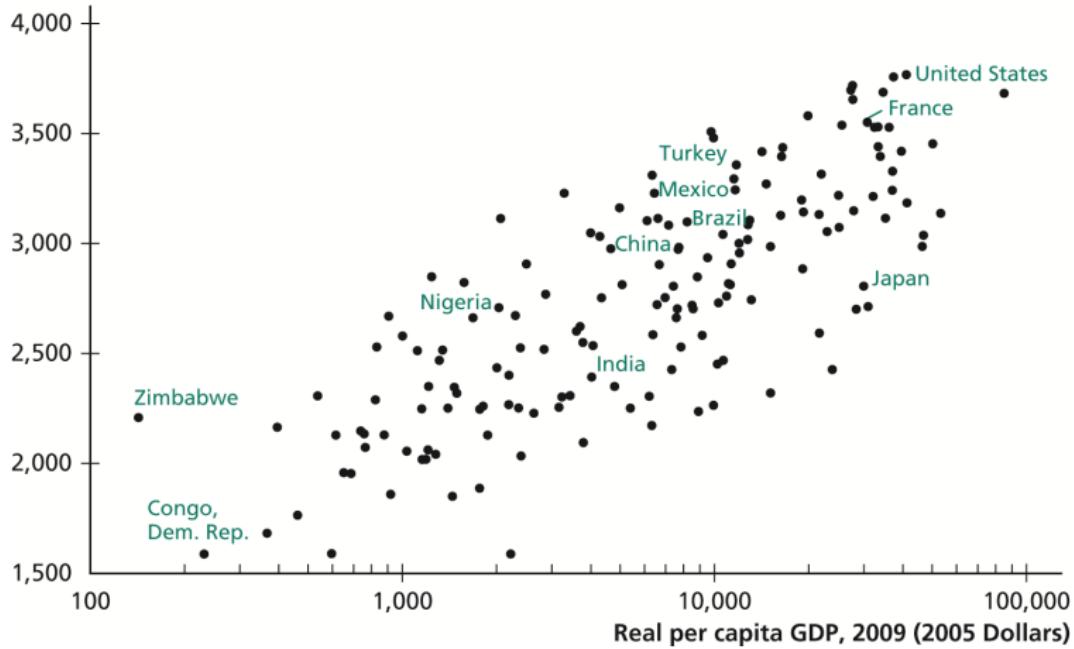
How do human capital

- in the form health, and
- in the form education

affect income differences across countries?

Calory Intake

Daily per capita supply of calories, 2007

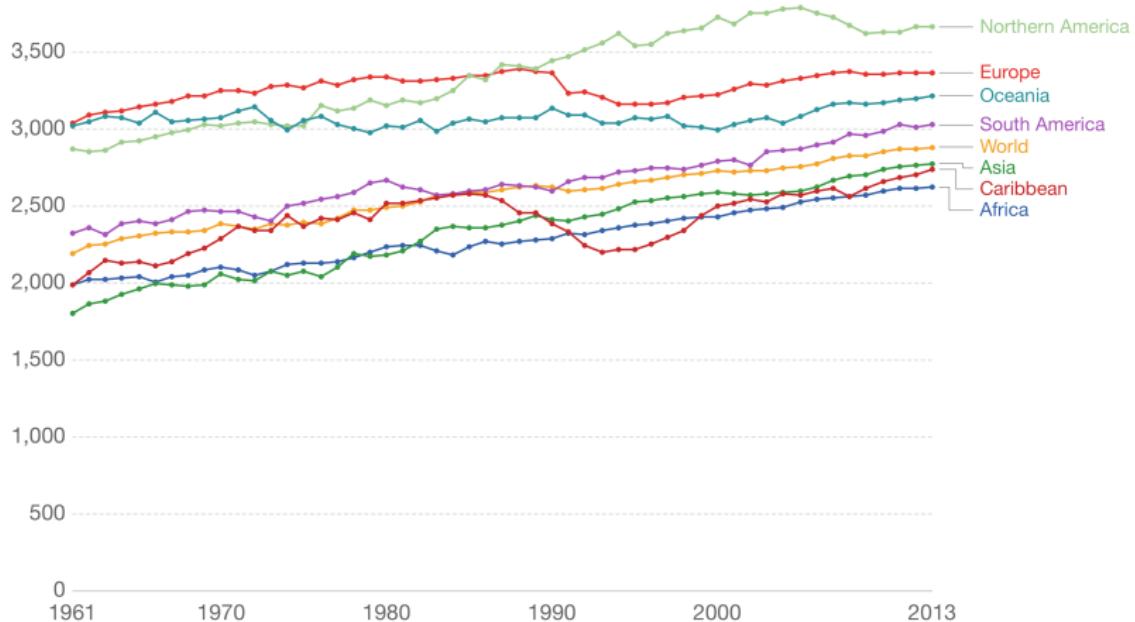


Sources: FAOSTAT database, Heston, Summers, and Aten (2011).

Graph from: Weil (2013)

Food energy supply by region

Daily per capita food supply by world region, measured on the basis of average caloric supply (kilocalories per person per day). Note that this measures the food available for consumption at the household level but does not account for any food wasted or not eaten at the consumption level.



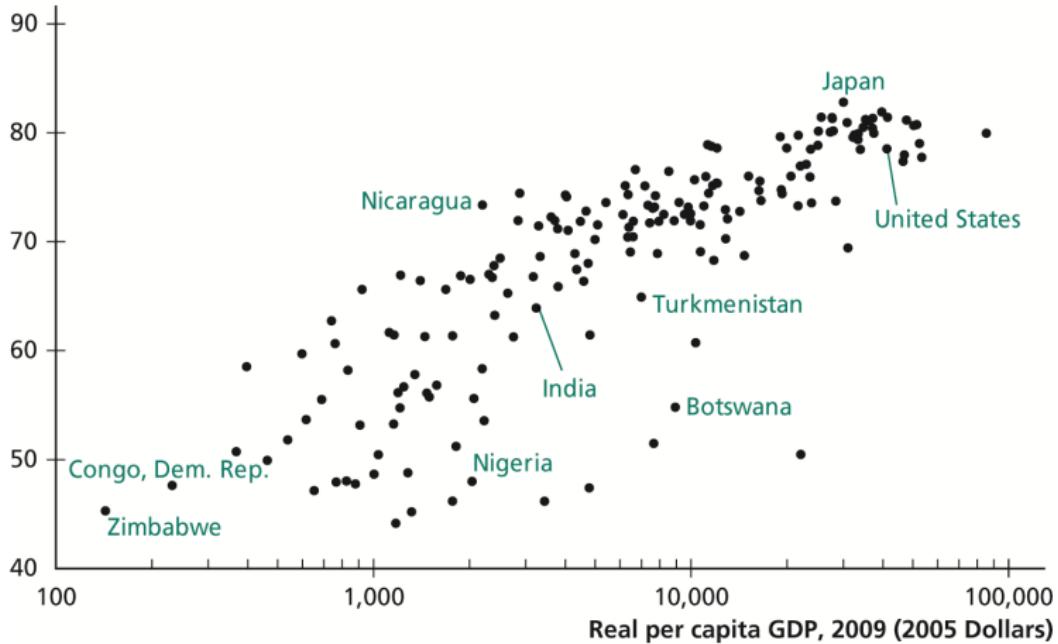
Source: UN Food and Agriculture Organization (FAO)

OurWorldInData.org/food-per-person/ • CC BY-SA

Graph from: www.ourworldindata.org

Life Expectancy

Life expectancy at birth, 2009

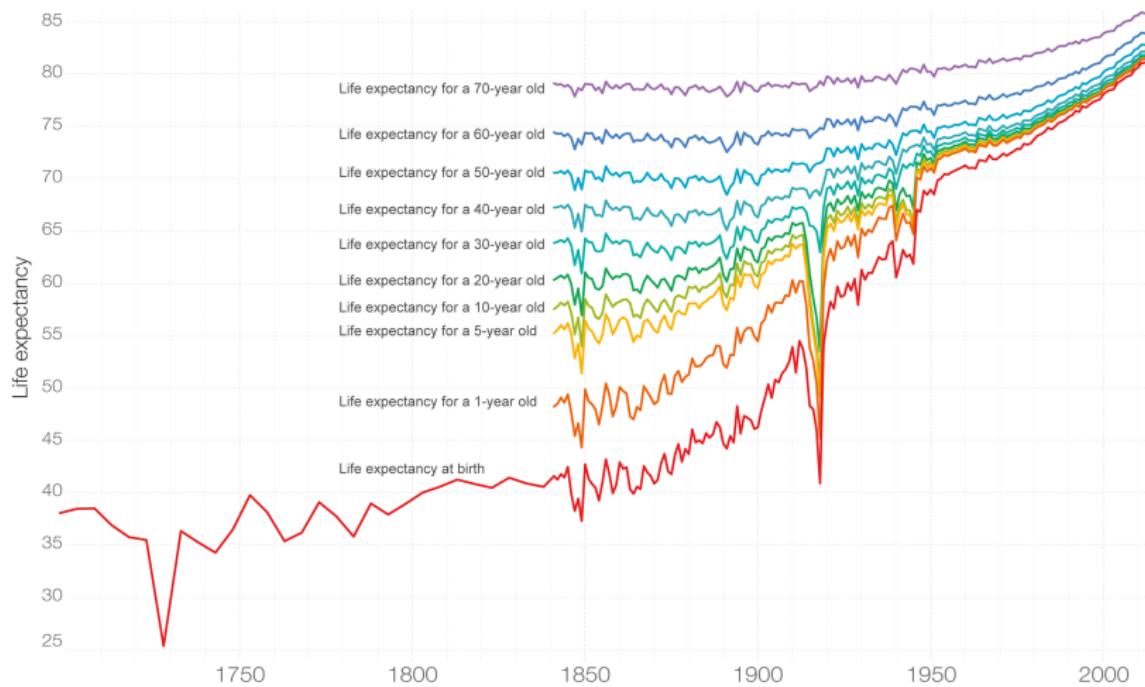


Sources: Heston, Summers, and Aten (2011), *World Development Indicators* database.

Graph from: Weil (2013)

Life Expectancy by Age in England and Wales, 1700-2013

Shown is the total life expectancy given that a person reached a certain age.



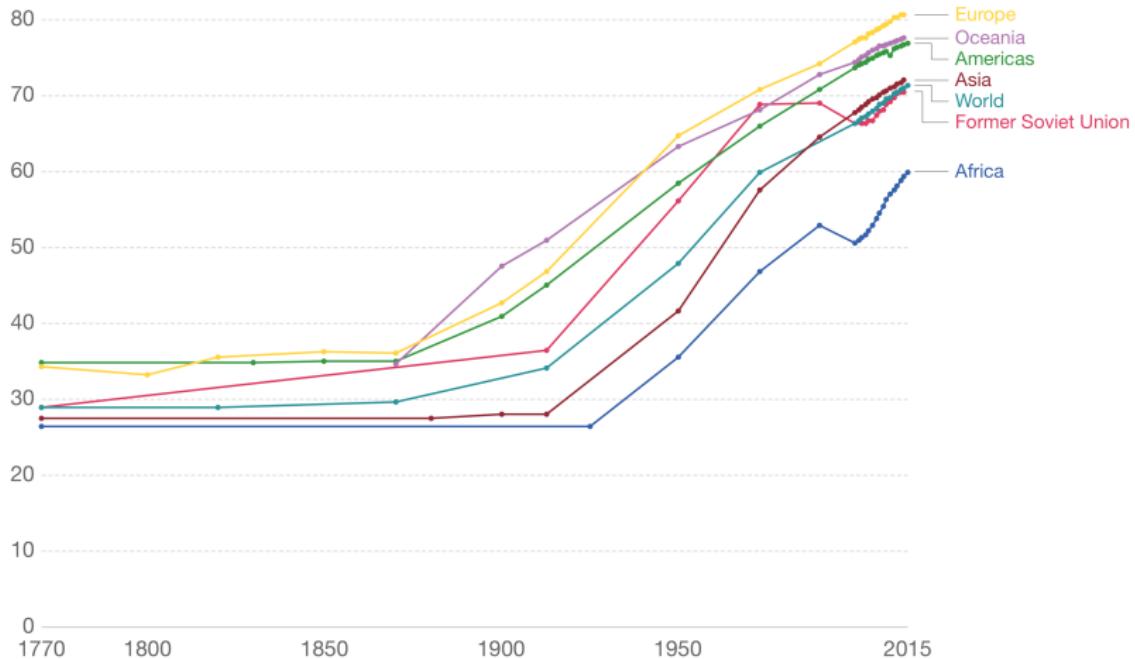
Data source: Life expectancy at birth Clio-Infra. Data on life expectancy at age 1 and older from the Human Mortality Database (www.mortality.org).

The interactive data visualization is available at OurWorldInData.org. There you find the raw data and more visualizations on this topic.

Licensed under CC-BY-SA by the author Max Roser.

Graph from: www.ourworldindata.org

Life expectancy globally and by world regions since 1770



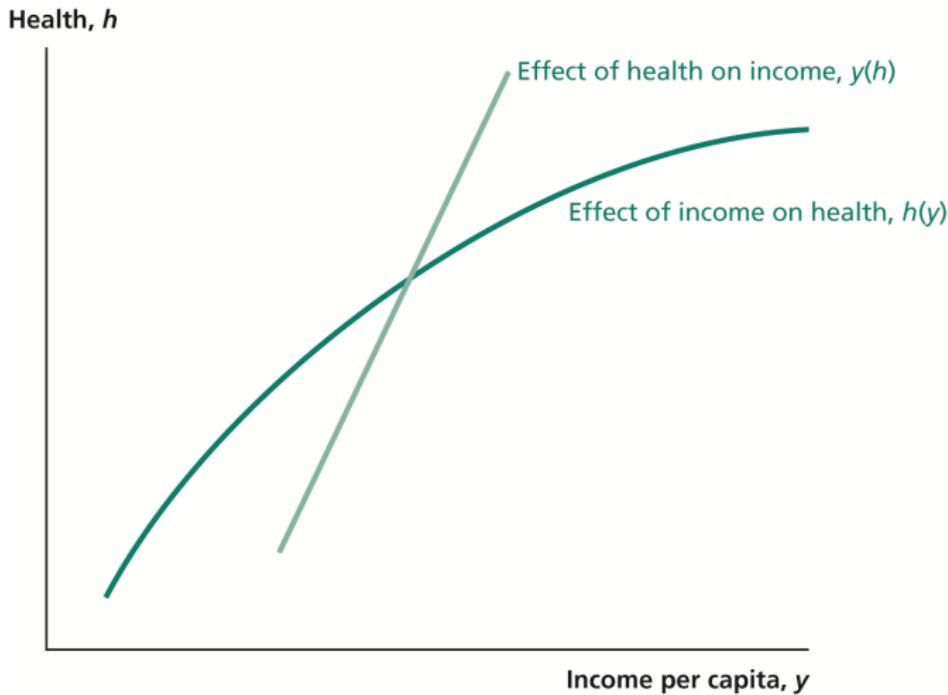
Source: Life expectancy – James Riley for data 1990 and earlier; WHO and World Bank for later data (by Max Roser)
OurWorldInData.org/life-expectancy/ • CC BY-SA

Graph from: www.ourworldindata.org

Human Capital in the Form of Health

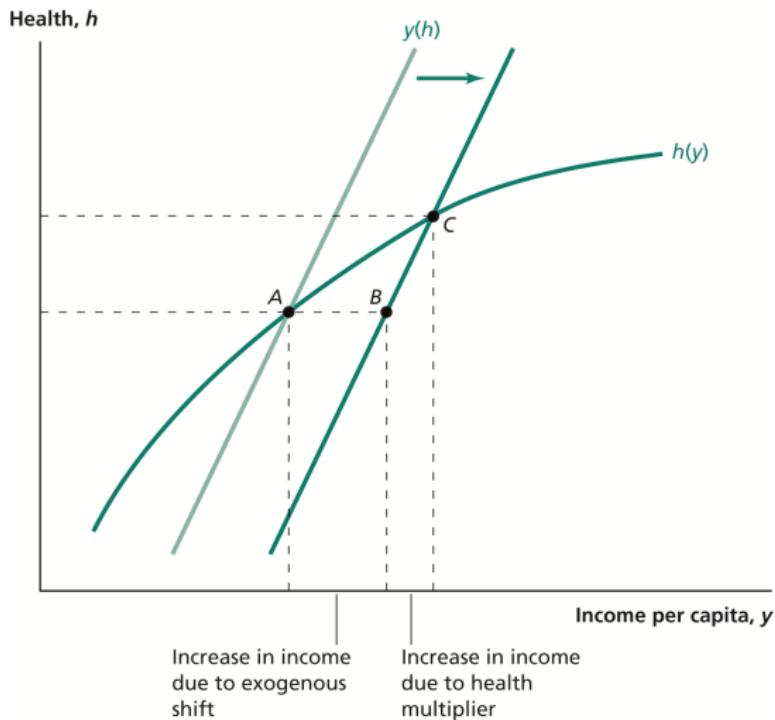
- Better nutrition, healthier workers \Rightarrow Higher income
 - healthier workers can work harder and longer
 - healthier people can think more clearly
- Higher income \Rightarrow better nutrition, healthier workers
 - United Nations Development Program (2000):
 - richer OECD countries: 2.2 doctors per thousand people
 - developing countries: .8 doctors per thousand people
 - sub-Saharan Africa: .3 doctors per thousand people
- Health and income are endogenous

How Health Interacts with Income



Graph from: Weil (2013)

Effect of an Exogenous Shift in Income



Graph from: Weil (2013)

Quantifying the contribution of nutrition on growth

Improved nutrition increased the UK growth rate by .33% a year from 1780 to 1980 (Robert Fogel)

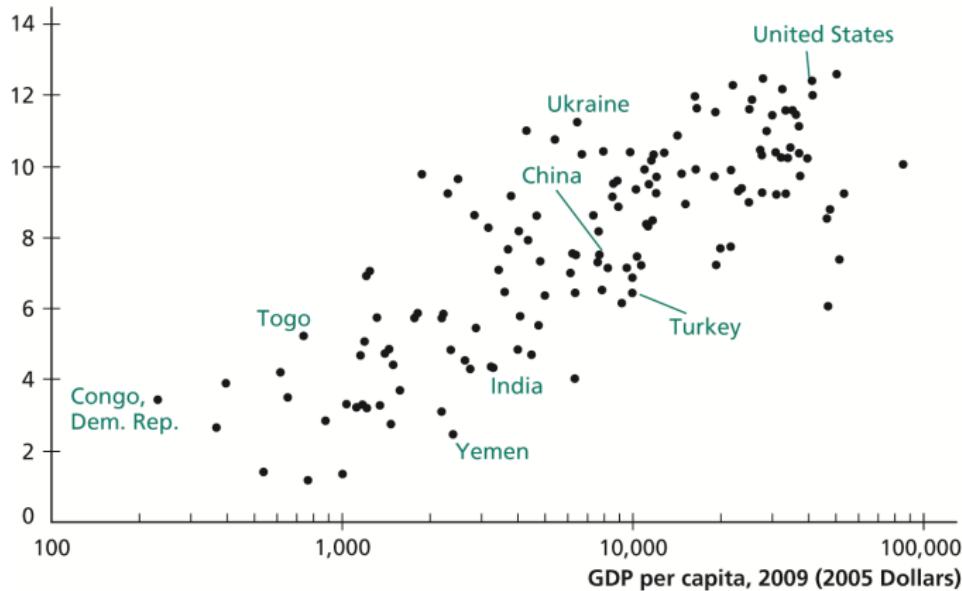
- In 1780, 20% of adults malnourished and unable to work
Elimination of malnourishment \Rightarrow 25% increase in labor supply
- \uparrow caloric intake \Rightarrow 56% increase in labor input

Human Capital in the Form of Education

- Intellectual ability is as important as health in determining a person's human capital
- Invest in human capital through education

Average Years of Schooling versus GDP per Capita

Average years of schooling, 2010



Sources: Barro and Lee (2010), Heston, Summers, and Aten (2011).

Graph from: Weil (2013)

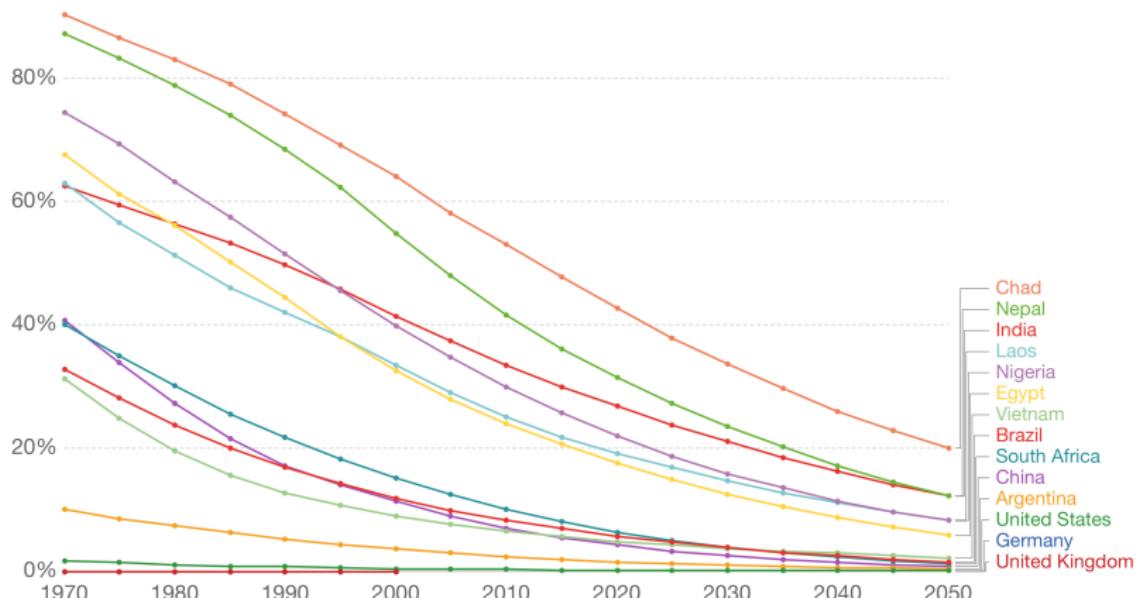
Changes in the Level of Education, 1975-2010

		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+.

Table from: Weil (2013)

Projected rate of no education



Source: International Institute for Applied Systems Analysis (IIASA); World Population and Human Capital in the Twenty-First Century (2015)

Note: The data on past and projected rates of educational attainment comes from the International Institute for Applied Systems Analysis (IIASA). These projections are constructed using current Global Economic Trends (GET). There are other scenarios available, including a best and worst case.

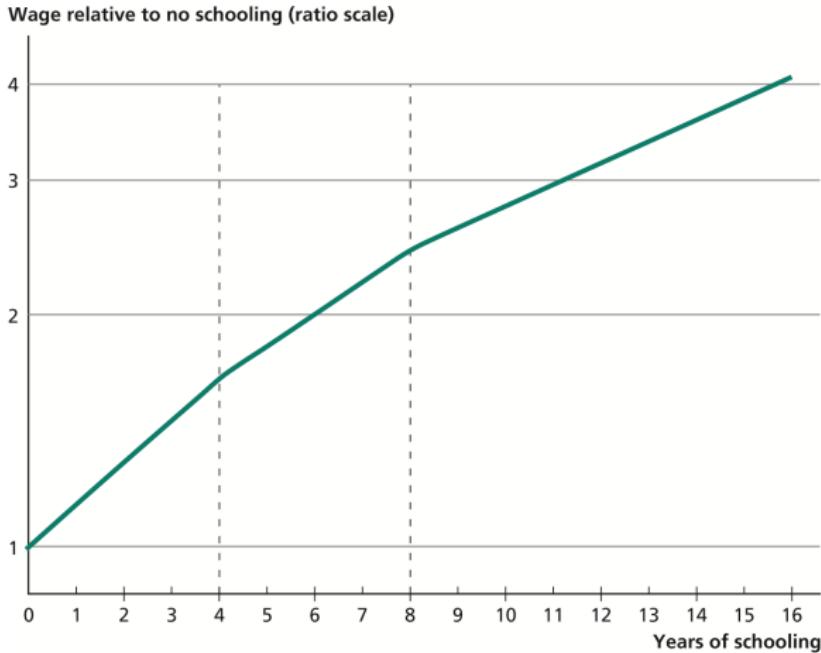
OurWorldInData.org/primary-and-secondary-education • CC BY-SA

Graph from: www.ourworldindata.org

Returns to Education

- Increase in wages that a worker would receive if she had one more year of schooling.
- Estimates from Hall and Jones (1999)
 - First 4 years (grades 1–4): 13.4%
 - Next four years (grades 5–8): 10.1%
 - Beyond eight years: 6.8%

Effect of Education on Wages



Graph from: Weil (2013)

Human Capital's Share of Wages

- 2/3 (approx.) of national income is paid to labor
- Wage is paid to the combination of the hours worked (raw labor) and their quality (human capital)
- How much is paid to raw labor?
- How much is paid to human capital?
- Suppose a worker has five years of education.
- His wage would be $1.1344^4 \times 1.101 = 1.82$ times wage of a worker with no education
- $.82/1.82 = 45\%$ to human capital, 55% to raw labor
- Now, apply this method to entire labor force

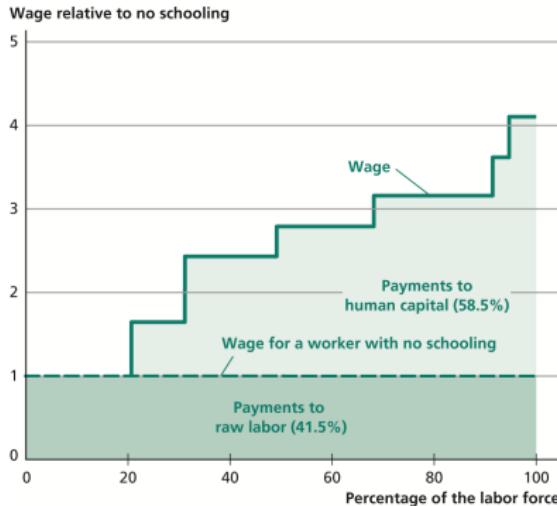
Breakdown of the Population by Schooling and Wages

Highest Level of Education	Years of schooling	Wage Relative to No Schooling	Percentage of the Population	
			Developing Countries	Advanced Countries
No Schooling	0	1.00	20.8	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	3.16	23.2	37.4
Incomplete Higher	14	3.61	2.9	9.9
Complete Higher	16	4.11	5.3	16.6

Source: Barro and Lee (2010).

Graph from: Weil (2013)

Share of Human Capital in Wages



Graphs from: Weil (2013)

- human capital's share of national income in developing countries = $2/3 \times 58.5\% = 40\%$
- human capital's share of national income in developed countries = $2/3 \times 67.7\% = 45\%$

Quantitative Analysis

How much of the variation in income across countries does education explain?

- Production function with human capital

$$Y = AK^\alpha(hL)^{1-\alpha},$$

where h is human capital

$$Y = h^{1-\alpha} AK^\alpha(L)^{1-\alpha}$$

$$\frac{Y}{L} = \frac{h^{1-\alpha} AK^\alpha(L)^{1-\alpha}}{L}$$

$$y = h^{1-\alpha} A \left(\frac{K}{L}\right)^\alpha \left(\frac{L}{L}\right)^{1-\alpha}$$

- Income per capita:

$$y = Ak^\alpha h^{1-\alpha}$$

Steady State Income per Worker

- Change in capital per worker

$$\dot{k} = \gamma A k^\alpha h^{1-\alpha} - (\delta + n)k$$

- Capital per worker is constant at the steady state

$$\gamma A(k^*)^\alpha h^{1-\alpha} = (\delta + n)k^*$$

- Capital per worker

$$k^* = \left[A h^{1-\alpha} \left(\frac{\gamma}{\delta + n} \right) \right]^{1/(1-\alpha)}$$

- Income per worker

$$y^* = A(k^*)^\alpha h^{1-\alpha}$$

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

Solow Predicted Income Differences

- Suppose country i and country j differ only with respect to their human capital level

$$\frac{y_i^*}{y_j^*} = \frac{\left[A^{1/(1-\alpha)} \left(\frac{\gamma}{\delta+n} \right)^{\alpha/(1-\alpha)} \right] \times h_i}{\left[A^{1/(1-\alpha)} \left(\frac{\gamma}{\delta+n} \right)^{\alpha/(1-\alpha)} \right] \times h_j} = \frac{h_i}{h_j}$$

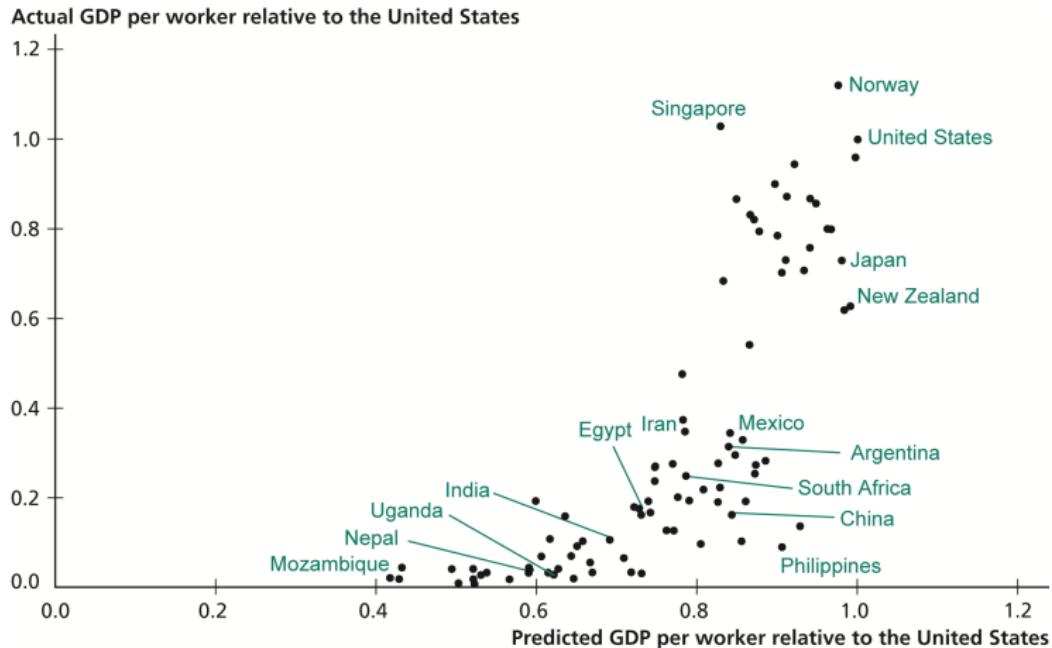
Measuring Human Capital

How can we measure human capital in the form of education?

$$h = h_0 \times \left(\left(\frac{w_1}{w_0} \right)^{t_1} \times \left(\frac{w_2}{w_1} \right)^{t_2} \times \dots \right)$$

- h_0 : level of labor input per worker with no schooling
- $\frac{w_i}{w_{i-1}}$: annual wage premium paid to education level i (primary, secondary, higher)
- t_i : years spend in education level i

Predicted versus Actual GDP per Capita

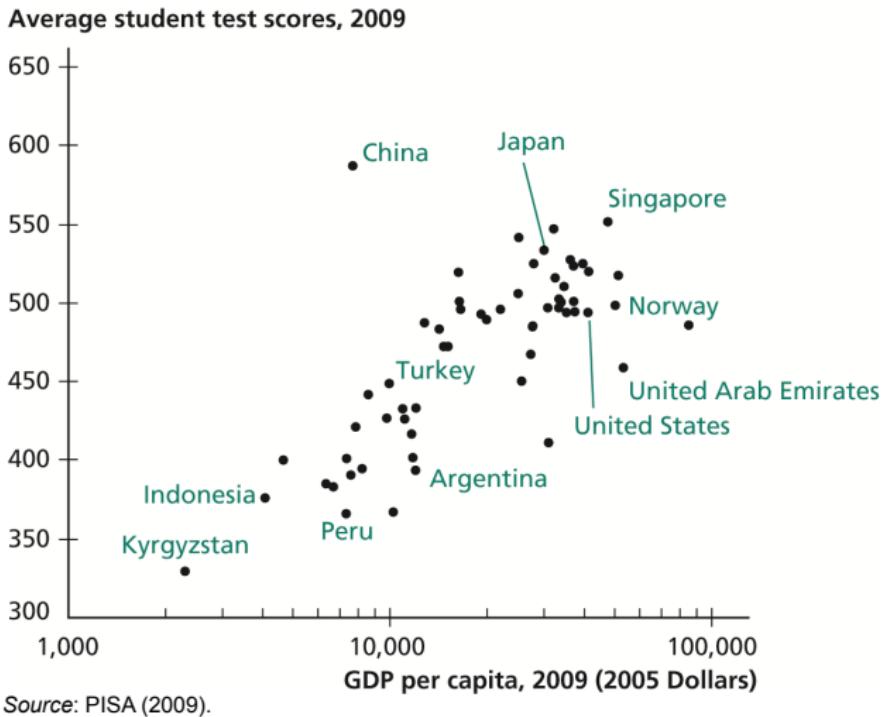


Graph from: Weil (2013)

Problem in Comparing Education Levels Across Countries

- quality of schooling might be different across countries
 - high income countries tend to have “better” schooling
 - average years of schooling understates the difference in human capital
- externalities
 - human capital could affect technology and efficiency levels
 - private return vs social return of education

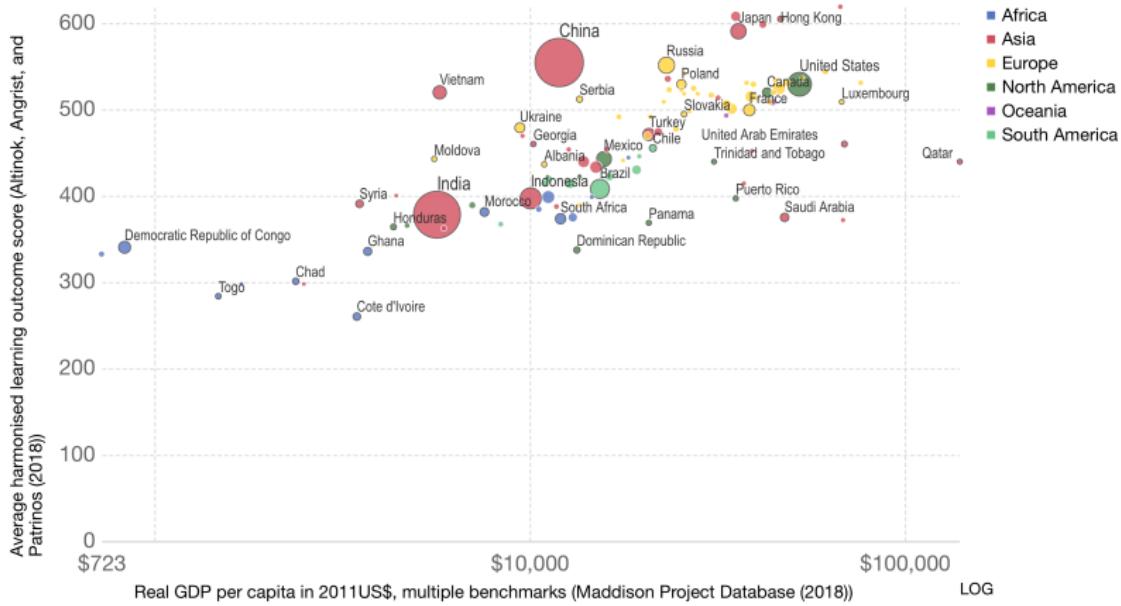
Student Test Scores versus GDP per Capital



Graph from: Weil (2013)

National average learning outcomes vs GDP per capita, 2015

The vertical axis shows average scores across standardized, psychometrically-robust international and regional student achievement tests. In order to maximize coverage by country, tests have been harmonized and pooled across subjects (math, reading, science) and levels (primary and secondary education). The horizontal axis shows GDP per capita after adjusting for price differences between countries and across time.

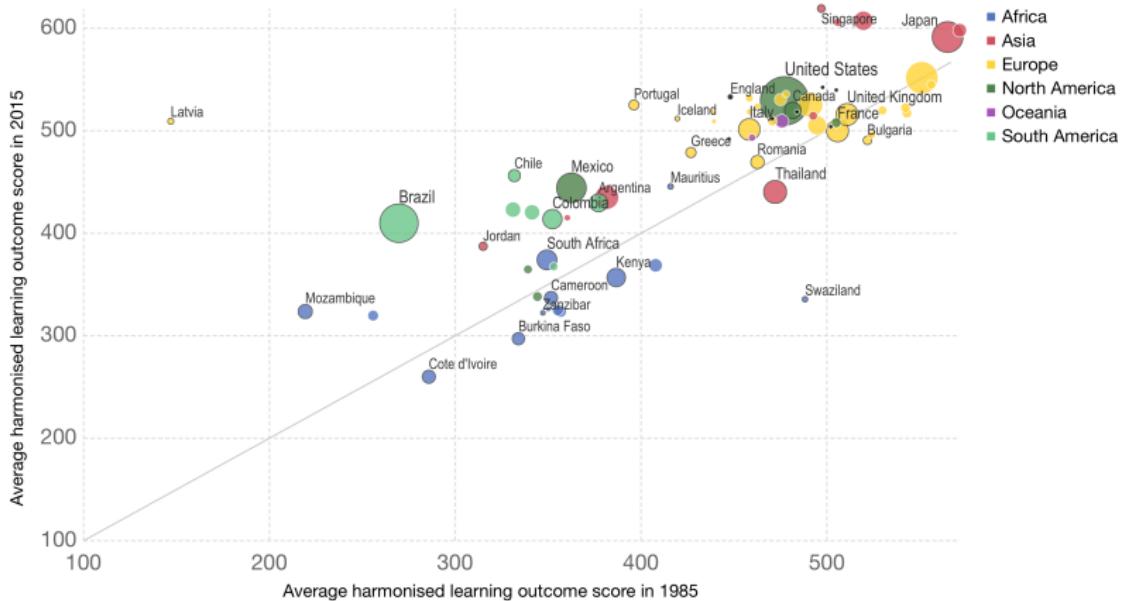


Source: Altinok, Angrist, and Patrinos (2018), Maddison Project Database (2018)

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National average learning outcomes, 1985 vs 2015

Average scores across standardized, psychometrically-robust international and regional student achievement tests. In order to maximize coverage by country, tests have been harmonized and pooled across subjects (math, reading, science) and levels (primary and secondary education). The observations correspond to 1985 and 2015, or closest year available.



Source: Altinok, Angrist, and Patrinos (2018)

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Graph from: www.ourworldindata.org

Summary

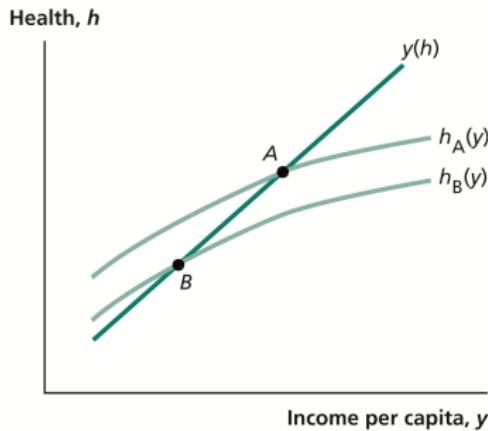
- Human capital in the form of health and education have positive effects on income.
- High income countries have higher years of schooling, and higher schooling quality.
- Years of schooling and quality of schooling have been improving all around the world.

Thank you!

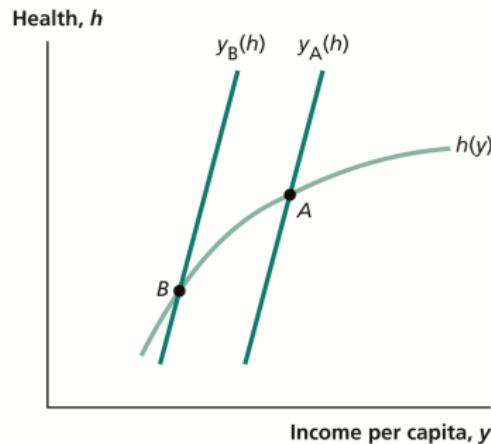
Health and Income per Capita: Two Views

Do the forces driving differences in income and health primarily from the side of health or income?

(a) The Health View



(b) The Income View



Graph from: Weil (2013)