Development Economics

Lecture 4: Human Capital

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1 Introduction

In this lecture I will discuss the macroeconomics of "human capital" in development economics. By human capital I essentially mean the ability of a worker to supply productive labor to an employer (wage employment) or herself (self-employment).

Health and **education** are two obvious potential determinants of labour quality, and will be the focus of this lecture.

Could it be that differences in health and education across countris can help explain the vast differences in income and standards of living more generally, across countries?

- I will follow Weil's exposition in Chapter 6 quite closely.

- I will also introduce the following paper:

Kingdon, G. and J. Knight "How flexible are wages in response to local unemployment in South Africa" Industrial & Labor Relations Review, Apr 2006, Vol. 59 Issue 3, p471-495.

Note that this is required reading for the first computer exercise (also note that you may be asked about this paper in the final exam).

2 Health

- Premise of the analysis: Healthy people can work harder and think more clearly than unwell workers. Healthy workers are therefore relatively more **productive**. It is therefore appropriate to say that health is part of an individual's human capital.

- Over the last century, the average level of health has **improved** in the world, for several reasons.
  - Advances in medicine.
  - Better nutrition.

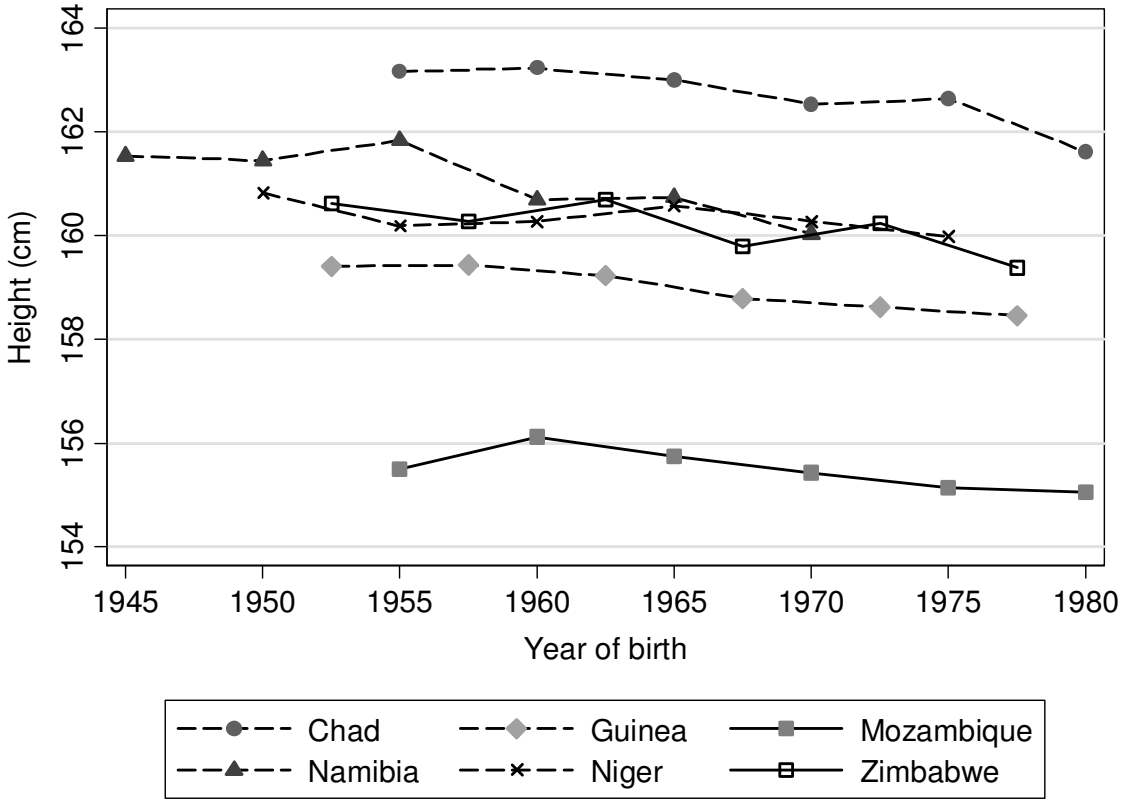
These developments **have led to** higher growth and economic development. But they are also **influenced** by economic development. More on this "chicken-and-egg" issue below.

- One visible effect of improved nutrition in the 20th century is that people have been getting **taller**. In a fascinating study Alexander Moradi, University of Oxford, looks at trends in the average height of the population in Sub-Saharan Africa (SSA) (Moradi, 2006).* For SSA the trend is a little different compared to the rest of the world. Looking at Figures 3-7 in his paper, it seems clear that, for most countries in his dataset, average height has **fallen** since the 1960s. According to the author, this is a direct result of the nutritional status having deteriorated during the last 30-40 years in SSA.

*Moradi, Alexander (2006). "Nutritional status and economic development in sub-Saharan Africa, 1950-1980," Global Poverty Research Group Working Paper GPRG-WPS-046. University of Oxford.

[Have a quick look at the graphs, taken from the Moradi paper; note that this paper is not required reading for the course - however I do recommend it]

Figure 3: Decreasing mean heights



Note: Birth cohorts are based on 5-year age groups (45-49, 40-44, ..., 20-24). The year of birth corresponds to the cohort mean and was assigned to the nearest 2.5-year segment. Cohorts with less than 100 individuals were excluded. All-women surveys, which are representative of the total female population, are in solid lines.

Source: Moradi, Alexander (2006). "Nutritional status and economic development in sub-Saharan Africa, 1950-1980," Global Poverty Research Group Working Paper GPRG-WPS-046. University of Oxford.

Figure 4: Stagnating mean heights

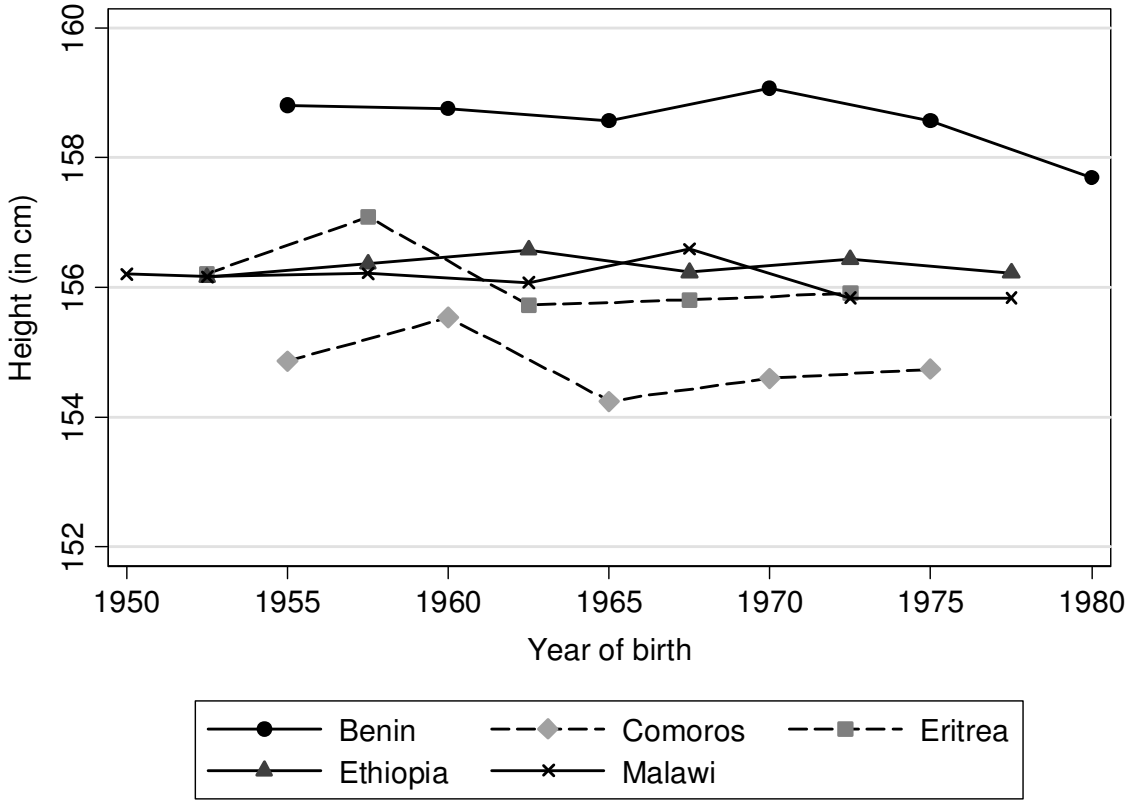


Figure 5: Height trends following an inverted U (1)

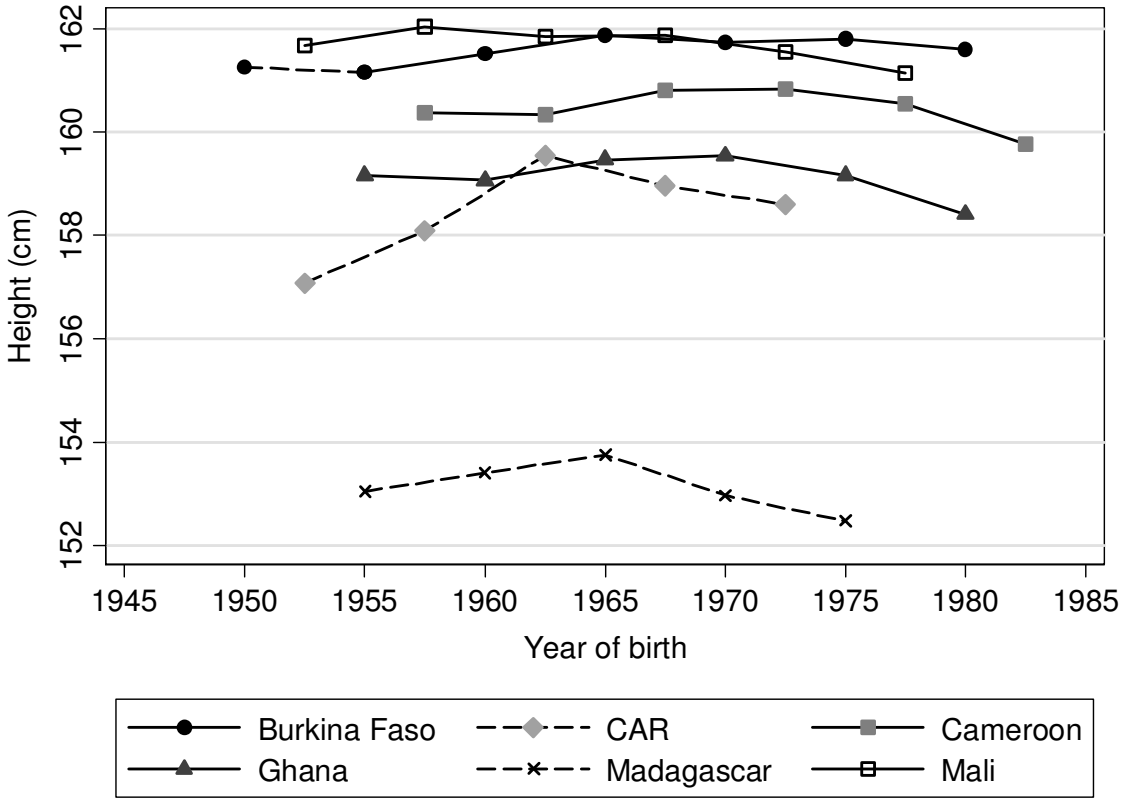


Figure 6: Height trends following an inverted U (2)

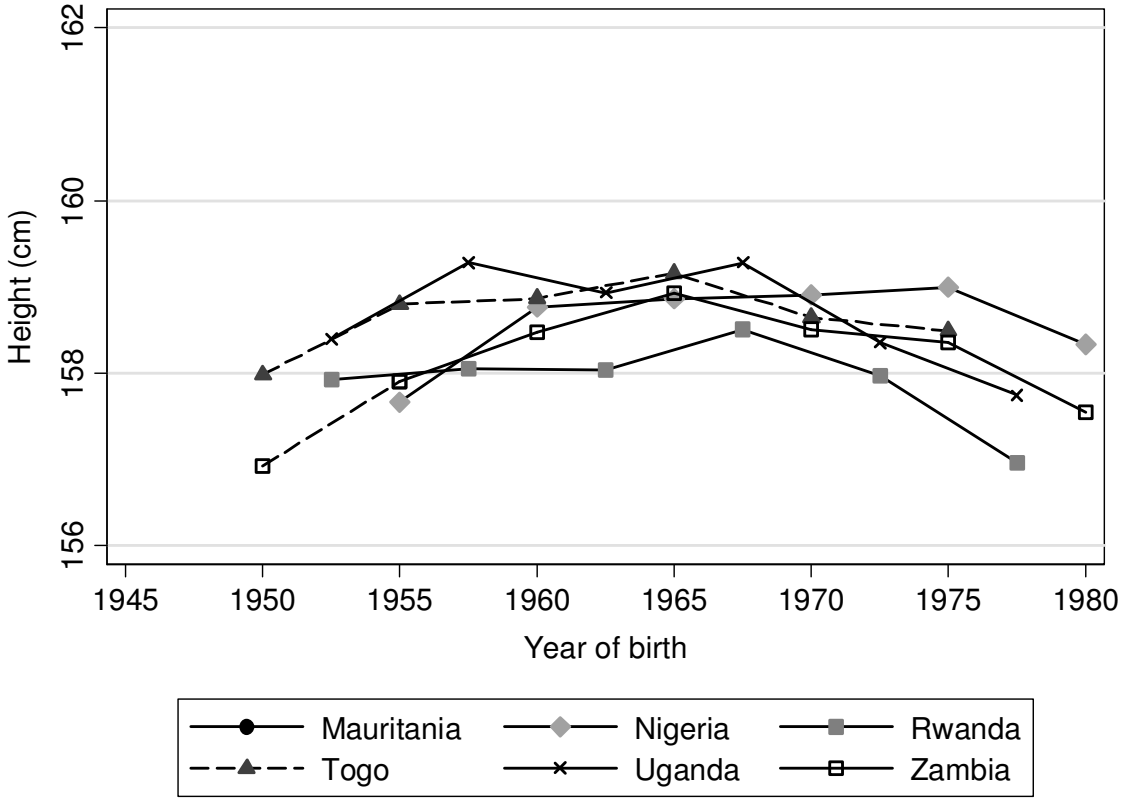
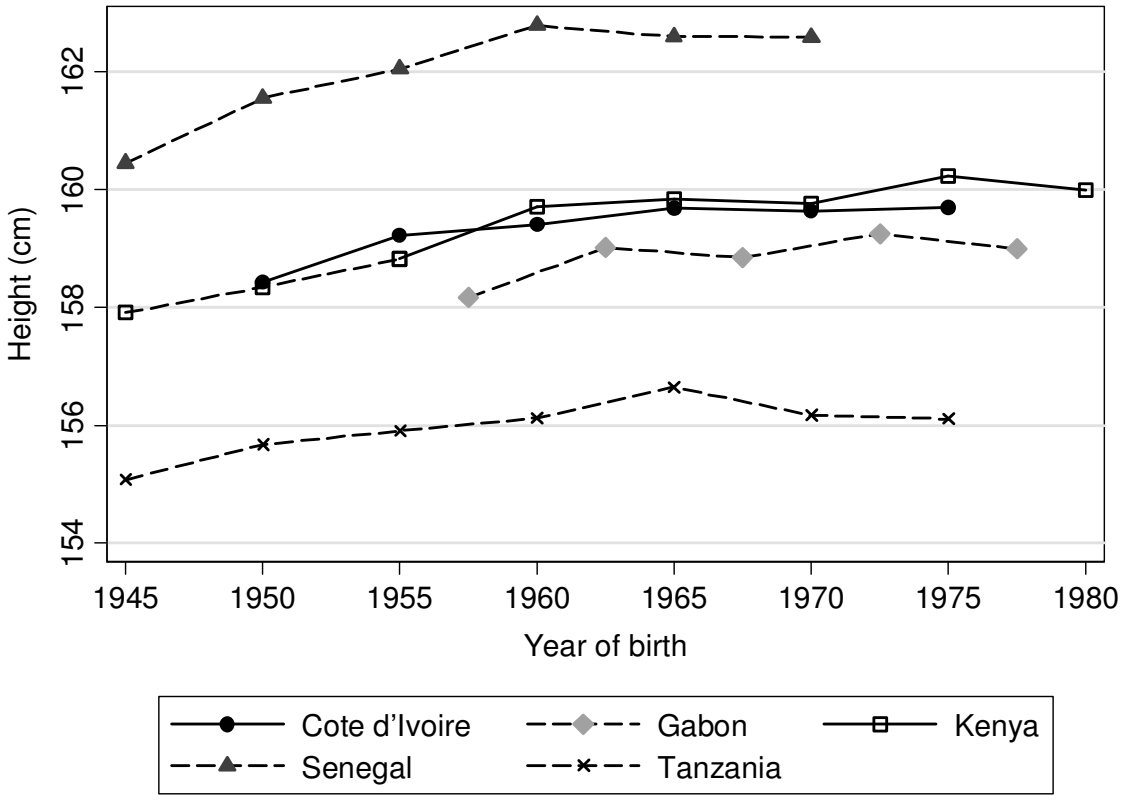


Figure 7: Increasing mean heights



- Two basic reasons why better nutrition raises economic growth:
  - Increased **quantity** of labour supply (more people can enter the labour force)
  - Improved **quality** of labour supply (people can work harder, or think more clearly)

- We can learn from **economic history:** Weil (p. 156) discusses a study by Robert Fogel (economics Nobel laureate), which quantifies the contribution of improved nutrition to economic growth in the UK between 1780 and 1980.
  - In 1780, 20% of the adults were unable to do any work because of malnutrition. In 1980, this was no longer an issue. This change thus

implies that the ratio of output per adult in the population in 1980 to that of 1780 was equal to $1/0.8 = 1.25$. That is, per capita output rose by 25% for this reason alone.

– Fogel also calculated that the amount of work performed by each worker in 1980 was 56% higher than it would have been in 1780, because of calorie intake was much higher in 1980 than in 1780.

– Taken together, these two effects imply that per capita output in 1980 was 1.25 x 1.56 = 1.95 times the level in 1780. This is the effect measured over 200 years. Converting it to an **annual** effect is straightforward:

$$1.95^{1/200} = 1.00334...$$

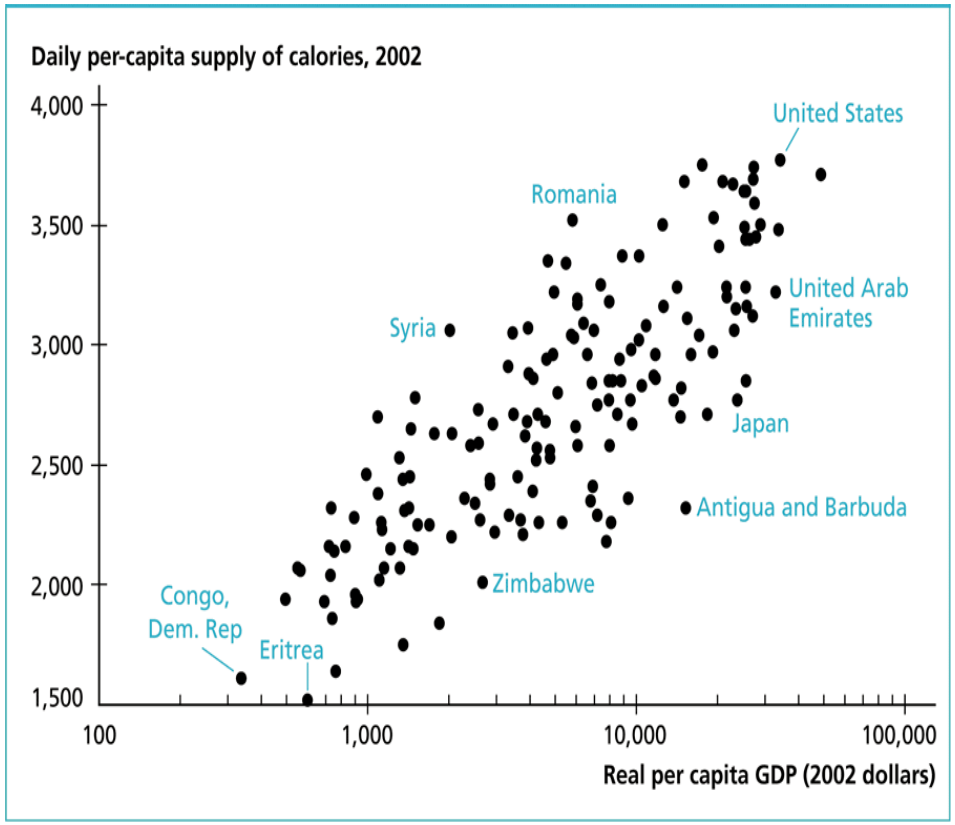
which amounts to 0.33% per year. The average annual growth rate in per capita income in the UK over this period was 1.15%.

  - Improved nutrition was clearly part of the growth process - although we don't really know if it **caused** the growth or if it was **caused by** growth (Weil is not very clear on this point I think - he says "...improved nutrition can be seen as having produced slightly less than one-third of the overall growth in income", suggesting that causality runs from health to income but that is in fact not certain).

- As you know malnutrition is still a big problem in poor countries. Figure 6.1 shows the association between calorie intake and real per capita GDP in the world; Figure 6.2 shows the relationship between life expectancy and per capita GDP (both graphs are taken from Weil's book).

[Fig. 6.1 & 6.2 here]

Figure 6.1: Calorie intake and GDP per capita

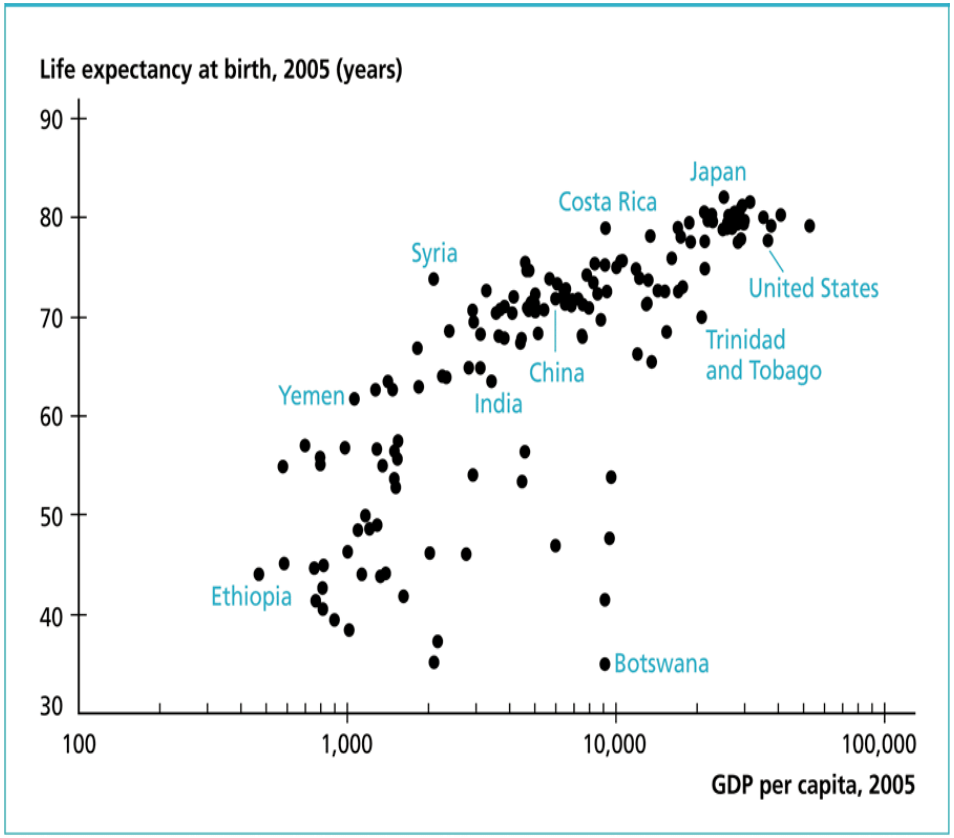


Sources: FAOSTAT database, Heston, Summers, and Aten (2006).

- Three striking insights:

1. Enormous differences in per capita GDP across countries in the world. Note that the horizontal axis is logarithmic (so the distance on the axis between $100 and $1,000 is the same as the distance between $10,000 and $100,000). In the poorest countries per capita GDP is less than $1,000; and in the richest countries it is more than $20,000.
2. Very large differences in average calorie intake across countries in the world. In several countries the average calorie intake is less than half of that in the US.
3. Strong positive correlation between calorie intake and per capita GDP.

Figure 6.2: Life expectancy and GDP per capita



Sources: Heston, Summers, and Aten (2006), World Bank (2007a).

- Insights:

1. Large differences in life expectancy at birth (e.g. compare Botswana & Japan)
2. Strong positive correlation between life expectancy and per capita GDP.

2.1 Health and income: What are the connections?

- We have talked briefly about the **causal effects** of health on income. In doing so, the thought probably occurred to you that richer countries can afford to supply their citizens with better access to health facilities, more effective drugs, more health-related information etc.

- In other words, causality runs...
  - from health to income; **but also**
  - from income to health

- The data presented by Robert Fogel should be viewed in this light. Maybe workers in the UK got healthier precisely because the UK got richer?

- Thus, for understanding the relationship between health and income, you need to recognize that **both are endogenous variables** that depend on each other. I think some simple maths may help to clarify things (this relates to the material in Weil but is actually not in the book).

- Suppose health (h) is a function of income (y) and some other factor u_h (perhaps reflecting the disease environment) as follows:

$$h = \alpha \cdot y + u_h,$$

where α is a parameter measuring the causal effect of income on health. Hence we expect $\alpha > 0$ (and we require $-1 < \alpha < 1$ for the system to be stable).

- Also suppose income is a function of health and some other factor u_y (perhaps reflecting institutional quality) as follows:

$$y = \beta \cdot h + u_y,$$

where β is a parameter measuring the causal effect of income on health. Hence we expect $\beta > 0$ (and we require $-1 < \beta < 1$ for the system to be stable).

- Now consider a positive exogenous shock to health (perhaps because a large number of mosquito nets are handed out to the rural poor in a malaria endemic region). In my little model, this increases u_h. What are the effects on a) health b) income?
  - 1. Direct effect on health. Clearly if u_h increases by one unit (say), then health (h) will increase by one unit. But that is not all.
  - 2. Indirect effect on health. The health improvement feeds into higher income through better health:

$$y = \beta \cdot h + u_y$$

and that in turn increases health further:

$$h = \alpha \cdot y + u_h,$$

because y is going up. That is, we have both u_h and y playing a role here.

- The total effects of the increase of u_h on health and income in this model can be obtained by rewriting the equations in reduced form. Hence, start from

$$\begin{aligned} h &= \alpha \cdot y + u_h \\ y &= \beta \cdot h + u_y \end{aligned}$$

and then plug in the second equation into the first one (this yields the health equation in reduced form); and the first equation into the second one (income equation in reduced form).

- Health equation in reduced form:

$$\begin{aligned} h &= \alpha \cdot (\beta \cdot h + u_y) + u_h \\ h\,(1 - \alpha\beta) &= \alpha u_y + u_h \\ h &= \frac{\alpha}{(1 - \alpha\beta)} u_y + \frac{1}{(1 - \alpha\beta)} u_h. \end{aligned}$$

- The income equation in reduced form is very similar:

$$y = \frac{\beta}{(1 - \beta\alpha)} \cdot u_h + \frac{1}{(1 - \beta\alpha)} u_y$$

- Insights:

  - The effect of the health shock on health is higher than just 1:1 (provided $\alpha \times \beta$ is positive and less than 1 - which is assumed here). This is

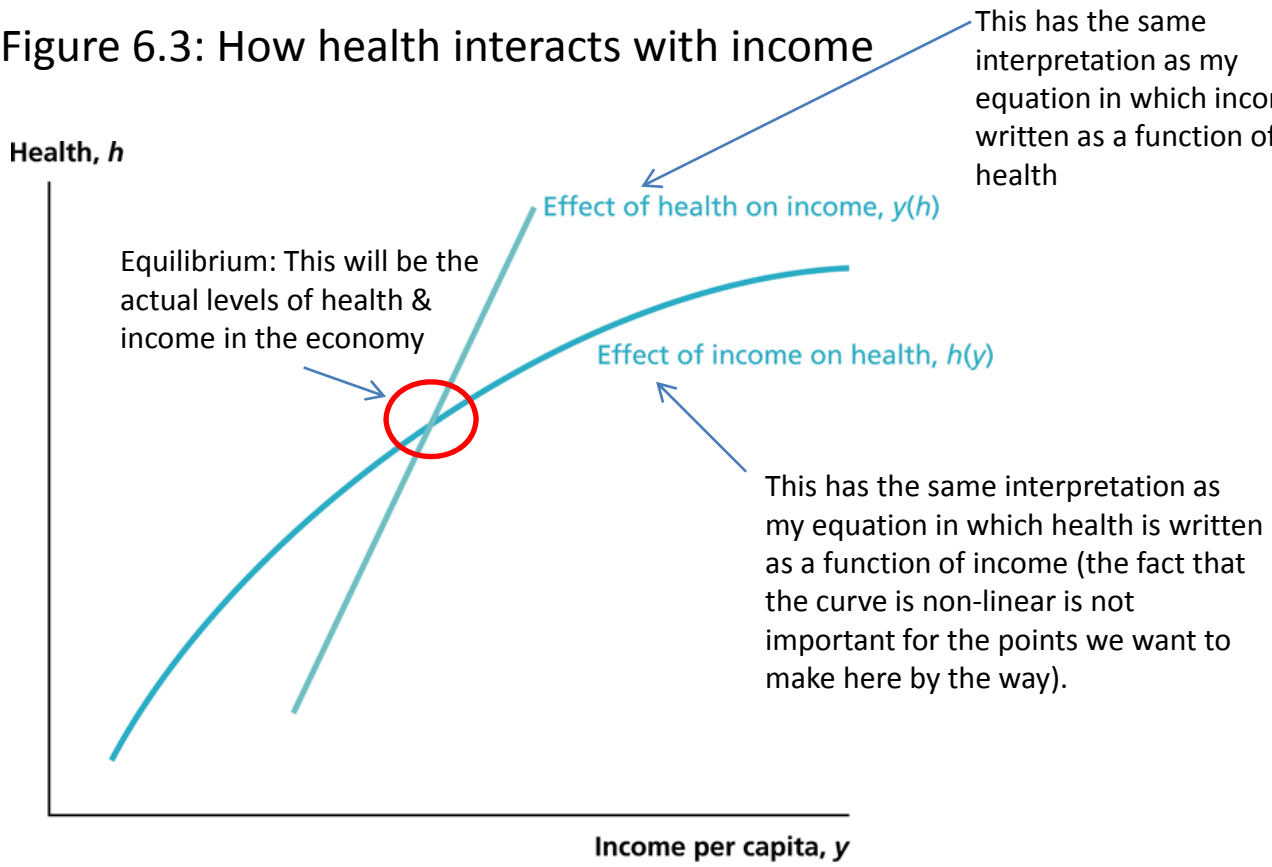
because it impacts on income, an effect that feeds back onto health. This is sometimes referred to as a **multiplier effect**.

  - The health shock impacts causally on income.

- Now let's redo this type of analysis using the diagram shown on p.159 in Weil.

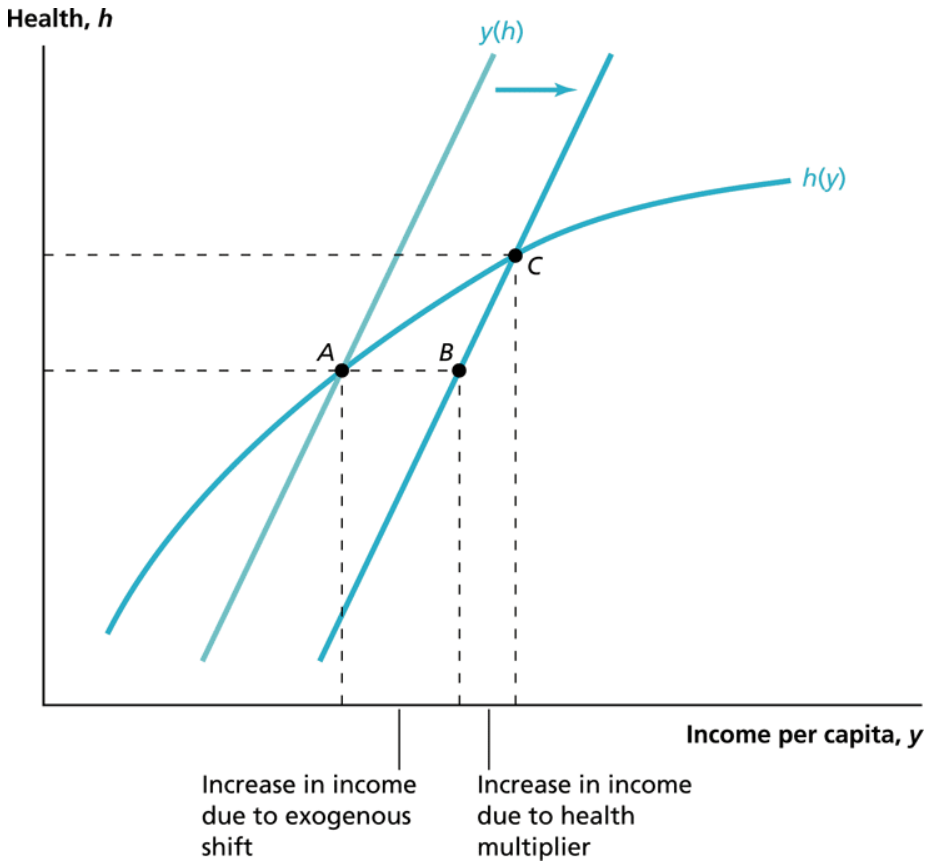
[Figure 6.3 here]

Figure 6.3: How health interacts with income



• Take this to be the starting point. Now consider the effects of an exogenous improvement in income (i.e. one **not** brought about by better health, but by something else – e.g. the discovery of diamonds)

Figure 6.3: How health interacts with income (continued)



- Events unfold as follows

1. From A to B: Direct effect of exogenous income shock on income. No effect on health yet.
2. As income rises, health will improve. This means we will start to move upwards from point B.
3. As we move upwards from B, and health improves, this feeds back into further increases in income. Thus we climb towards point C, which is the new equilibrium.

What would the graph look like if causality **only** runs from health to income? Interpret.

3 Human Capital in the Form of Education

- By far the most researched aspect of human capital in economics is **education**. As you know, more and better schooling is often considered a key driver of growth and development pretty much everywhere.

- Indeed, the level of education has increased substantially over the last 30-40 years.
  - In developing countries average years of schooling **more than doubled** between 1960 and 2000, from 2 to slightly more than 5 years. Still, about a third of the population in developing countries have no schooling - see Table 6.1 in Weil for more striking facts on schooling around the world.

- Education is an investment in building human capital. Countries tend to spend a lot of money on it, often several percentages of GDP (see Weil pp.163-65)

- **How do we know if it pays off?** A vast amount of research has looked into the returns to education. The most common outcome variables to look at are i) wages ii) income. We discuss this next.

3.1 Education and Wages

- Someone considering taking a Bachelor course in economics in Gothenburg might think about the economic consequences of his or her decision.

- There are clearly costs associated with taking such a course - e.g. the opportunity cost (the earnings you could have earned had you been working instead) and direct costs (e.g. costs of books; in some countries you would have been faced with high tuition fees as well).

- The good news (hopefully) is that completing the course significantly improves your prospects of getting a better job in the future than you otherwise would have been able to. It is likely that there will be some positive pecunary return to your education that you will enjoy in the future, and that will balance out the costs you are now incurring.

- The **return to education** is defined as the increase in the expected wage that a worker would receive if he or she had one more year of schooling.

- Indeed, look at any dataset with information on earnings and education, and you will almost certainly find that education is positively correlated with earnings.

3.1.1 Illustration: Earnings and education in South Africa

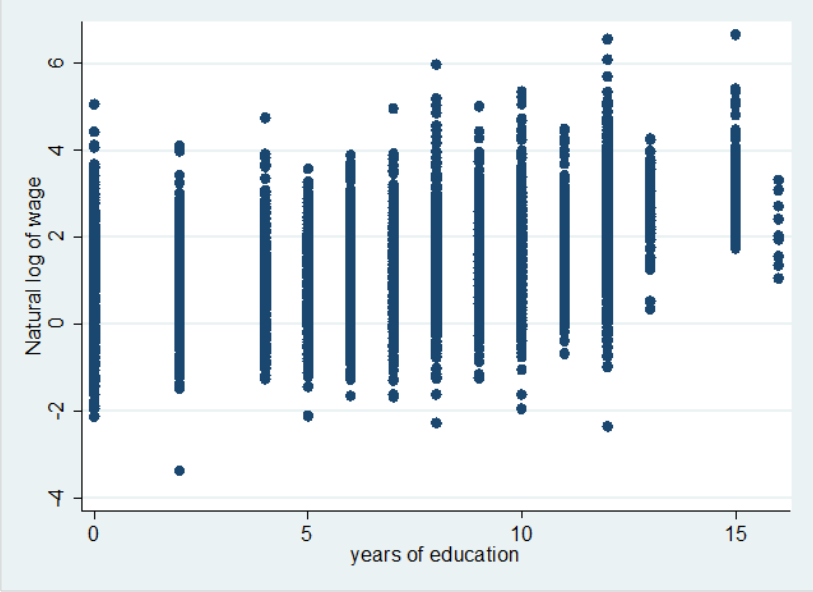
In the first computer exercise we will use household data from South Africa to investigate the determinants of wages. The data were collected as part of the South African Living Standards Survey, organized jointly by the World Bank and the South African Labor and Development Research Unit (SALDRU) at the University of Cape Town in the second half of 1993.

This household survey produced cross-section data on 8,848 households with regards to labor force participation, employment status, earnings, education, hours worked in the past week, job-search activity, occupation, industry, and employer type. For a thorough analysis of these data, see the article by Kingdon and Knight (2006).

[A first look at the South African data]

Using the South African Household data: Scatter plot, correlation and an OLS regression in Stata

```
use "C:\teaching_gbg08\C_dev_econ09\sa_wage_curve_1.dta", clear

generate lw=ln(wphy)   /* generate natural log of wage */

label var lw "Natural log of wage"

scatter lw edyrs

corr lw edyrs

regress lw edyrs
```




```
. corr lw edyrs
(obs=6980)

             |       lw    edyrs
-------------+------------------
          lw |   1.0000
       edyrs |   0.5125   1.0000

.
. regress lw edyrs

      Source |       SS       df       MS              Number of obs =    6980
-------------+------------------------------           F(  1,  6978) = 2486.11
       Model |  2242.29712     1  2242.29712            Prob > F      =  0.0000
    Residual |  6293.66923  6978  .901930242           R-squared     =  0.2627
-------------+------------------------------           Adj R-squared =  0.2626
       Total |  8535.96635  6979  1.22309304           Root MSE      =   .9497

------------------------------------------------------------------------------
          lw |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       edyrs |    .138002   .0027677    49.86   0.000     .1325764    .1434276
       _cons |   .4611801    .024596    18.75   0.000     .4129645    .5093957
------------------------------------------------------------------------------
```

Quick detour: Interpreting regression results when the dependent variable is in logarithmic form The simple regression model on the previous page is of the following form

$$\ln w = \alpha_0 + \alpha_1 E + e,$$

where w is wage and E is years of education. The estimate of the coefficient α_1 is 0.138, and the t-value is 49.9. What does this mean?

First, let's think about the interpretation of α_1. Importantly, when the dependent variable is expressed in logarithmic form, it makes sense to interpret the results in **percentage terms**. Clearly

$$\frac{d \ln w}{dE} = \alpha_1.$$

But notice also:

$$\alpha_1 = \frac{d \ln w}{dE} = \frac{dw/w}{dE} \simeq = \frac{\frac{\Delta w}{w}}{\Delta E}.$$

Hence, if education changes by 1 year, so that $\Delta E = 1$, then wage will change by α_1, or, equivalently, $100 \times \alpha_1\%$. It's important that you are clear on this. Second, the high t-value means we reject the null hypothesis that the true value of α_1 is actually zero.

- The results above thus suggest one additional year of education will increase wages by 14%, in the relevant population. If we assume this reflects causality running from education to earnings, then the return to education is 14%; the labour market clearly values the skills that individuals acquire through education.

- BUT NOTE! Correlation does not imply causality! It might be that the labour market actually values skills that you do **not** learn through formal

education. Employers will still want to pay individuals with a lot of education more, because the employers know that such individuals tend to have those skills as well (e.g. being "smart"). If this is the case, education does not **cause** higher productivity.

- There is a vast empirical literature on the returns to education in rich as well as poor countries. Such studies infer the returns to education from differences in average earnings across people with different levels of education. The data are usually "micro data", i.e. microeconomic data on individuals obtained from household surveys, for example. Some really tricky econometric issues crop up when trying to estimate the returns to education. The "Gordian knot" is to isolate the causal effect of education, separating it from effects of other factors that are hard to get data on. Recently I heard a very famous economist who said - tongue in cheek I

think - that after decades of research on the returns to education, we are now confident that the return to education is between 0 and 20%. The bottom line is that nailing causality is a very tricky issue.

- Abstracting from methodological difficulties, the estimated rates of return to education vary a lot across countries and over time, and there is little consensus as to what the "correct" return might be (you may have noticed that economists have doubts about everything - this is especially true for the returns on education!). Based on a survey of the literature done by George Psacharopoulos[†], Weil adopts the following ballpark numbers for the rate of return:
  - you get 13.4 percent per year for the first 4 years of schooling (this is the average rate of return for SSA, reported by Psacharopoulos)

[†]Psacharopoulos, George, "Returns to Investment in Education: A Global Update," *World Development*, 1994, 22 (9), 1325-1343.

  - then 10.1% per year for the next 4 years (this is the average rate of return for the World, according to Psacharopoulos),

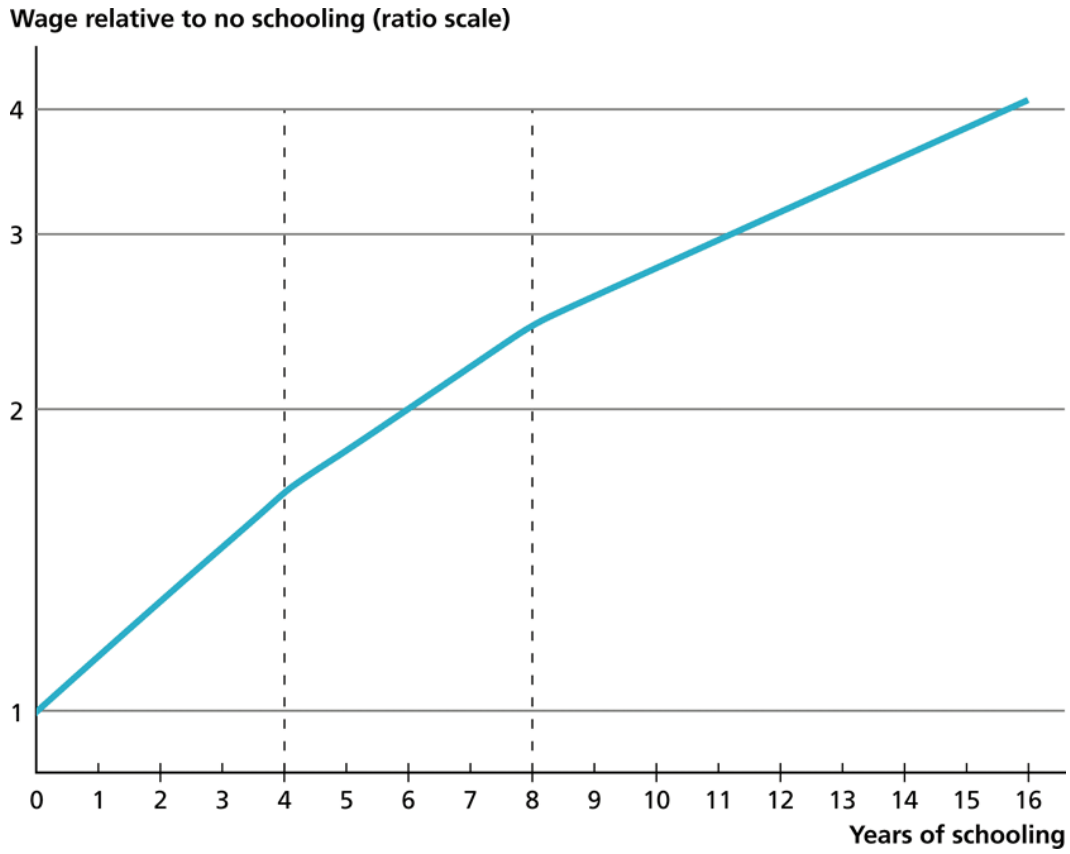
  - and then 6.8% beyond 8 years of schooling (this is the average rate of return for the OECD countries, according to Psacharopoulos).

- How much higher is the (average) wage for someone with 16 years education compared to someone with no education?

- Based on the above estimates of the rate of return, Weil illustrates in Figure 6.6 how wages vary with education, relative to the wage of someone with no schooling

[Figure 6.6].

Figure 6.6: Wages and Education



Why might the graph be **concave**?

4 The Macroeconomics of Education, Income and Growth

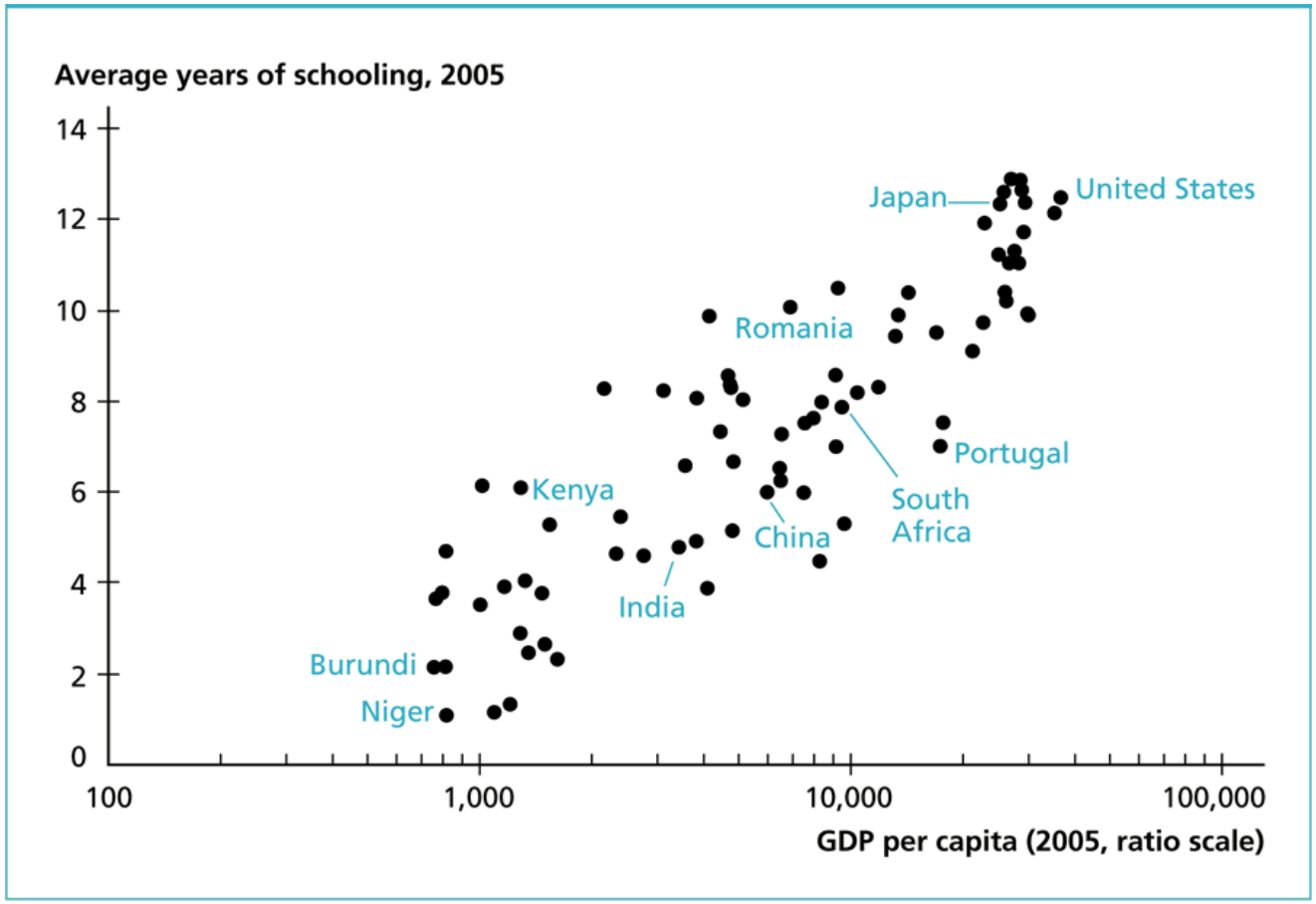
The last subsection in Section 6.2 in Weil (pp. 167-173) contains a discussion of human capital's share of wages. The discussion is really easy to follow, but frankly not all that interesting I think. Please read if you want to. I will now move on to a discussion of the macroeconomic effects of education on the level of income, based on Section 6.3 in Weil.

4.1 The effect of education on the level of income

You will not be surprised to learn that there is a strong correlation between education and per capita GDP across countries in the world.

[Figure 6.11]

Figure 6.11: Per Capita GDP and Education in the World



Sources: Cohen and Soto (2007); Heston, Summers, and Aten (2006); World Bank (2007a).

CAUSALITY??????

- Causality may run in both directions:
  - Schooling may raise income because education makes people more productive and efficient
  - Income may raise schooling because richer countries can afford to spend more on education.

- What is the causal effect of schooling on the level of income?

- To find this effect, Weil extends the Solow framework that you have seen a couple of times already in this course to incorporate human capital. Specifically, the production function is now written

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

where remember Y is output, A is the level of technology (or productivity), K is physical capital (machinery etc.), h is the average level of human capital in the country's workforce, L is the number of workers, and α is a parameter.

- My first goal is to find out how human capital affects the steady-state level of per capita output.

- Building on expressions used earlier in the course, I rewrite the production function as follows:

$$Y = \left(Ah^{1-\alpha}\right) K^{\alpha} L^{1-\alpha}.$$

This is exactly the same production function as that used in earlier chapters in Weil's book, except the term A has now been replaced by $\left(Ah^{1-\alpha}\right)$, thus allowing an explicit effect of human capital on income.

- You have seen in earlier chapters and lectures the expression for steady-state level of per capita output:

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

where recall that n is the population growth rate, δ is the depreciation rate of physical capital, and γ is the savings rate. Using our "new" production function, with an explicit role for human capital, we thus write the steady-state level of per capita output as follows:

$$\begin{aligned} y^{ss} &= \left(Ah^{1-\alpha} \right)^{\frac{1}{1-\alpha}} \left(\frac{\gamma}{n+\delta} \right)^{\frac{\alpha}{1-\alpha}} \\ y^{ss} &= \left(A^{\frac{1}{1-\alpha}} h \right) \left(\frac{\gamma}{n+\delta} \right)^{\frac{\alpha}{1-\alpha}} \\ y^{ss} &= h \times \left[A^{\frac{1}{1-\alpha}} \left(\frac{\gamma}{n+\delta} \right)^{\frac{\alpha}{1-\alpha}} \right]. \end{aligned}$$

This is neat, because it is now totally clear that the steady-state level of output is **directly proportional** to the average human capital in the economy.

- Now consider the causal effect of human capital on per capita income. By causal, we mean the change in output that occurs as a result of changing h holding **everything else** equal. So a useful thought experiment is to ask how income would differ across two hypothetical countries that are **identical** in every respect (with regards to the relevant economic parameters) **except** country i has more human capital than country j. Using the equation just derived, the ratio of per capita income in country i to that of country j is thus equal to

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

(quite deliberately, I only put i, j subscripts on human capital terms as all other parameters are assumed the same in the two countries).

- There is thus a 1:1 effect of human capital on the steady-state level of income in this model.

- Now - and this is important - schooling is **not** the same thing as human capital. The algebra above is useful for setting the scene for analyzing the effect of schooling, but on its own it does not tell us anything about the causal effects of schooling.

- The **missing link** is thus between schooling and human capital. In fact, once we have written down the model above, our original question "what is

the effect of schooling on income?" may as well be reformulated as "what is the effect of schooling on **human capital**?" - we already "know" (by writing down the equations above) the effect of human capital on income.

- What is the effect of schooling on human capital? Recall the discussion earlier about wages and education. If we maintain the assumption that the wage differences we observe in data across individuals with different levels of education arise because more educated workers have more human capital, we can learn something about the quantitative effects of education on human capital from earnings regressions.

- This is precisely what Weil and others before him are doing when using the data in Psacharopoulos to draw inference on the returns to education. So let's go along with this, assuming the return to education to be 13.4%

at low levels of education, 10.1% at intermediate levels, and 6.8% at high levels.

- We are now in business, because we can quantify the effect of schooling on income. The standard reference for data on schooling across countries is the Barro-Lee dataset. According to this dataset, the average years of education in the adult population in Niger in 2000 was 1.02 years. The corresponding number for the U.S. was 12.05 years. Now use the information we have collected to estimate the average level of human capital in Niger and the U.S.

  – Niger:

$$h_{Niger} = 1.13^{1.02} \times h_0 = 1.133 \times h_0,$$

  where h_0 is the level of human capital associated with no education.

– The U.S.:

$$h_{US} = 1.13^4 \times 1.101^4 \times 1.068^{4.05} \times h_0 = 3.176 \times h_0$$

- Thus: the vast difference in average schooling levels across the two countries feeds into a large difference in human capital.

- Now, had the U.S. and Niger been identical in every other respect except schooling levels, one would predict the U.S. to be 2.8 times richer than Niger:

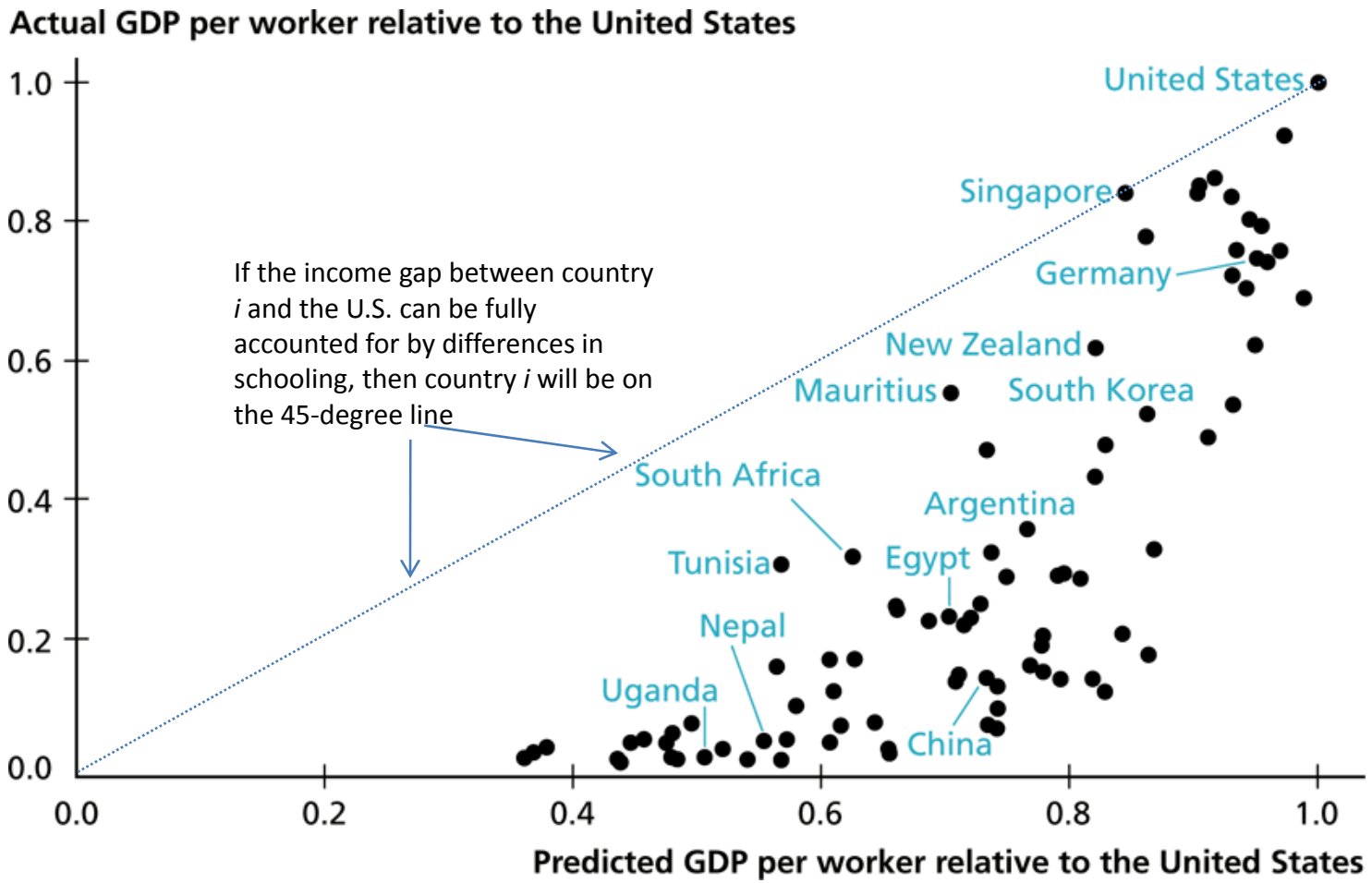
$$\frac{y_{US}^{ss}}{y_{Niger}^{ss}} = \frac{h_{US}}{h_{Niger}} = \frac{3.176 \times h_0}{1.133 \times h_0} = 2.803.$$

- Is this a lot? While the magnitude is certainly not trivial, this predicted differential is **nowhere near** the actual difference in income between the countries. The per capita GDP in the U.S. in 2000 was about $33,300 while in Niger it was $875 - the U.S. is thus **38 times** richer than Niger! Clearly other factors play an important role in determining income.

- Figure 6.12 in Weil shows the result of using this analysis for all the countries in the world, using the U.S. as the benchmark.

[Figure 6.12]

Figure 6.12: Predicted & Actual GDP per worker



- Where would Niger be in this graph?

- What does the graph suggest about the role of education in explaining cross-country differences in income?

4.2 The Quality of Schooling

- The analysis above used years of schooling as the measure of the level of education. Is this likely to be a good (complete) measure? Well if you believe that the quality of schooling is the same in all countries and over time, then yes. But this is clearly not the case. In poor countries, resources (e.g. books, flip charts,...) are much more limited of course and the teachers themselves are typically less educated than in rich countries. So not only do kids in rich countries get more in terms of schooling quantity, *they also get higher schooling quality*.

- Think about how Figure 6.12 would change if we used a measure of schooling that took quality differences into account.

4.3 Externalities

- Many economists believe that education is the source of positive **externalities** (an externality is an effect for which no compensation is paid - being exposed to passive smoking is a negative externality; having a neighbor who grows beautiful flowers in her garden is a positive externality).

- The idea is that less educated individuals can learn, and become more productive, by watching highly educated colleagues (for example) performing certain work tasks. Thus one person's education can raise the production of many.

- Clearly if there are such externalities it makes a lot of sense for governments to subsidize education (why?).