Written Exam at the Department of Economics summer 2018

Development Economics

Model Answers

30. May 2018

(3-hour closed book exam)

Answers only in English.

NB: If you fall ill during an examination at Peter Bangsvej, you must contact an invigilator in order to be registered as having fallen ill. In this connection, you must complete a form. Then you submit a blank exam paper and leave the examination. When you arrive home, you must contact your GP and submit a medical report to the Faculty of Social Sciences no later than seven (7) days from the date of the exam.

Be careful not to cheat at exams!

- You cheat at an exam, if during the exam, you:
- Make use of exam aids that are not allowed
- Communicate with or otherwise receive help from other people
- Copy other people's texts without making use of quotation marks and source referencing, so that it may appear to be your own text
- Use the ideas or thoughts of others without making use of source referencing, so it may appear to be your own idea or your thoughts
- Or if you otherwise violate the rules that apply to the exam

Problem A
Please provide short answers to the following questions and statements:

1. In comparing levels of development across countries: What is the difference between using the HDI index (Human Development Index) and GDP per capita?
   The difference is that health and schooling enters into the HDI index in addition to GDP per capita. If the student notes that the HDI index is (loosely) associated with the "capability approach" to development, it is a plus.

2. Please explain how it is possible to argue that
   2.1. Global inequality has increased from around 1980 to around 2000
   2.2. Global inequality has decreased from around 1980 to around 2000
   2.3. Global inequality has been roughly constant from around 1980 to around 2000
   The three arguments are related to three different ways of computing global inequality, as explained in Milanovic (2013). When the global Gini-coefficient is based on income per capita for each country, *without population weighting* (Concept 1), then global inequality increased from around 1980 to 2000. When the global Gini-coefficient is based on income per capita for each country, *with population weighting* (Concept 2), then global inequality decreased from around 1980 to 2000. Finally, when the global Gini-coefficient is based on individual incomes (Concept 3), then global inequality has been roughly constant from around 1980 to 2000. This is shown in Milanovic (2013, Figure 2).

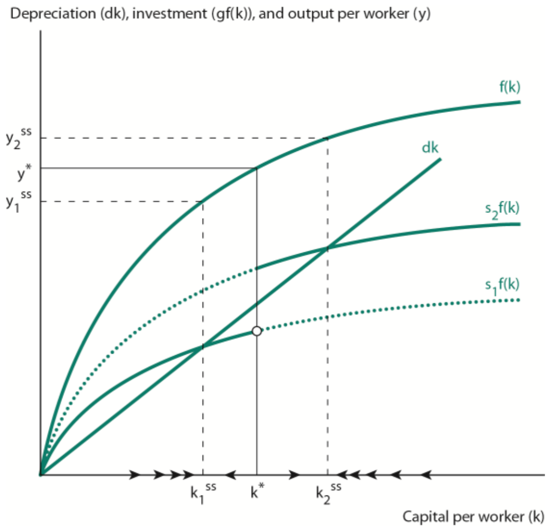
3. Please explain how Robert Allen estimates global least cost food poverty lines
   Allen exploits that minimum expenditures given nutritional requirements in a diet can be found by linear programming. Depending on the number of (strict) requirements wrt., dietary contents of say, (i) calories; (ii) protein and fat; and (iii) micro nutrients, minimum expenditures on a local diet, paid in local prices, can be computed. The minimum expenditures in local prices can converted to *country specific* least cost food poverty lines, expressed in PPP-adjusted international dollar. Hence, the food poverty lines computed by Allen has fixed nutritional contents, but different expenditures in PPP$.

4. Please define and explain development accounting
   Development accounting is explained in Weil (2013, Section 7.1). The main question we seek to answer is "how much productivity differs among countries". To look into this we consider output per worker in two countries (county 1 and 2). The ratio of output per worker can be decomposed into two ratios: Factors of production and productivity:
   $$\frac{y_1}{y_2} = \frac{A_1}{A_2} \frac{k_1^{\alpha} h_1^{1-\alpha}}{k_2^{\alpha} h_2^{1-\alpha}}$$
   where we assume the production function in both countries is Cobb-Douglas with constant returns to scale and the same elasticities wrt. capital and labor input. Having observable data for output per worker, capital per worker and human capital per worker, we can compute the ratio of productivities
   $$\frac{A_1}{A_2} = \left(\frac{y_1}{y_2}\right) \Big/ \left(\frac{k_1^{\alpha} h_1^{1-\alpha}}{k_2^{\alpha} h_2^{1-\alpha}}\right)$$
   This split of the ratio of output per worker into the ratio of factors of production and the ratio of productivities is development accounting. It is very useful in understanding the relative importance of input factors and productivity when we compare rich and poorer countries.

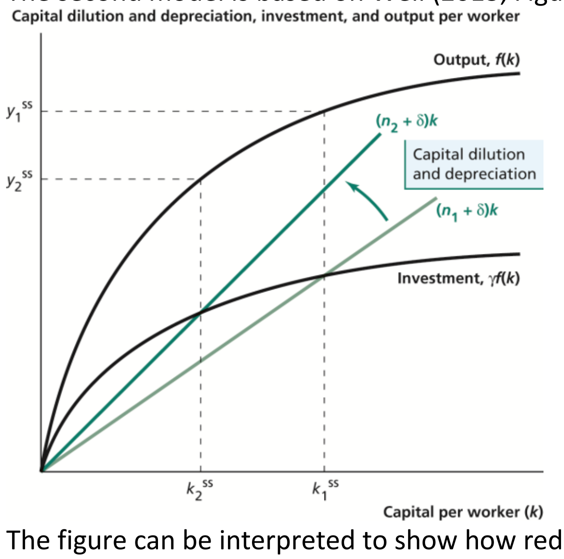
5. Consider a country where mortality is the key driver of desired family size. (i) Why would mortality affect optimal fertility? (b) What policy advise (provide two examples) would be

relevant in the country if one would like to bring down fertility.
The key reason why mortality may affect optimal fertility is that parents may be risk averse. In an environment featuring high (child) mortality, the risk of ending without offspring may induce parents to increase the expected number of children from a precautionary perspective. When mortality declines this will lessen the precautionary motive and bring down the expected number of offspring (hence, net fertility). (b) Initiatives that serve to reduce the mortality environment would have good chance reducing fertility. For example, investments in sanitation and/or public health clinics.

6. Please sketch or draw two simple growth models in which a temporary inflow of foreign aid may have permanent effects on the level of income per capita.
Foreign aid may have permanent effects on the level of income per capita if there is a shift in a parameter in the growth model, which is an indication of something akin to a poverty trap. Weil (2013) has two examples: In Figure 3.9 he illustrates a Solow model with saving dependent on the income level. Savings and investments are low when output per worker is below y* (when capital intensity is below k*), while savings and investments are high when output per worker is above y*. This model has a "jump" in the line representing investment.



The second model is based on Weil (2013, Figure 4.7):



The figure can be interpreted to show how reducing the population growth rate from n_2 to n_1 affects the steady state level of capital per worker and the steady state level of output per worker. If fertility is a function of income, as for the savings rate above, then this gives rise to a model with multiple equilibria as above.

7. Please, explain what debt overhang is.
   A creditor may be is better off providing the borrower with some debt forgiveness if the alternative is that the borrower will have to default on the loan. The difference between the actual debt of the borrower, and the “sustainable” (and thereby serviceable) amount of debt, is called the “debt overhang”.

Problem B

Human capital in the form of education is closely linked to economic development.

B1: Please illustrate and discuss the anticipated impact of human capital on GDP per capita both in the short run, using growth accounting, and in the long run, based on a Solow-model with exogenous human capital formation.

Starting with the development accounting, we compare GDP per worker in two countries, assuming they produce output using the same technology:

$$\frac{y_1}{y_2} = \frac{A_1 k_1^{\alpha} h_1^{1-\alpha}}{A_2 k_2^{\alpha} h_2^{1-\alpha}} = \frac{A_1}{A_2} \times \left(\frac{k_1}{k_2}\right)^{\alpha} \times \left(\frac{h_1}{h_2}\right)^{1-\alpha}$$

This decomposition illustrates the influence of human capital on relative differences in GPD per worker. Using the decomposition, we can compare, say, India and USA. In 2009, the level of human capital in India was 2/3 of the level of human capital in USA (Weil, Table 7.2). If this were the only difference between India and USA, we would expect GPD per worker in India to be ¾ (0.758) of GDP per worker in USA, assuming that α = 1/3.

In the standard Solow model with exogenous human capital, the steady state the ratio of GDP per worker is

$$\frac{y_1^*}{y_2^*} = \left(\frac{A_1}{A_2}\right)^{\frac{1}{1-\alpha}} \times \left(\frac{\left[\frac{s_1}{n_1+\delta_1}\right]}{\left[\frac{s_2}{n_2+\delta_2}\right]}\right)^{\frac{\alpha}{1-\alpha}} \times \left(\frac{h_1}{h_2}\right)$$

where the star on y_i indicates steady state levels, s_i is the savings rates in each country, n_i, the population growth rate and δ_i the capital depreciation rate (i=1,2). The expression shows that in the long run the ratio of GDP per worker will be directly proportional to the ratio of human capital, which is a larger effect than given in the development accounting. The reason for the difference is that capital intensity is endogenous in the Solow model.

B2: Please explain how the return to schooling can be estimated using (a) micro data on individual earnings and (b) macro data on average schooling and GDP per capita. Describe the differences that are obtained using micro and macro data, respectively, to estimate the return to schooling and give possible explanations for the discrepancy.

The return to schooling is traditionally estimated using the so-called Mincer regression in which wages (in logs) are regressed on years of schooling and experience:

$$\ln W_i = \beta_0 + \beta_1 S_i + \beta_2 Experience_i + \beta_3 Experience_i^2 + \varepsilon_i$$

Here the left hand side variable is the wage rate for an individual, while the explanatory variables are years of schooling (S) and experience (years working) . Here the return to an additional year of schooling is given by b_1. An alternative formulation that may be used is

$$\ln W_i = \beta_0 + \delta_1 Primary_i + \delta_2 Secondary_i + \delta_3 Tertiary_i + \beta_2 Experience_i + \beta_3 Experience_i^2 + \varepsilon_i$$
$$\text{with } r_P = \delta_1 / S_P, \quad r_S = (\delta_2 - \delta_1)/(S_S - S_P), \quad r_T = (\delta_3 - \delta_2)/(S_T - S_S)$$

where the return to an additional year of primary, secondary and tertiary education is estimated by r_P, r_S and r_T, respectively.

When return to schooling is estimated using macro data (as in Barro and Lee), GDP per worker is regressed on capital per worker and average years of education in the population:

$$\ln y_i = \mu + \alpha \ln k_i + (1-\alpha)\theta s_i + \omega_i$$

Where the index is now over countries. Here, s_i is the average year of schooling in country i, say in India, and t, measures the return to an additional year of education (in terms of increased GDP per worker), analogous to the Mincer regression.

Comparing results for the two types of estimates of returns to schooling across countries there are noticeable differences. For the “world” the estimates differ slightly, as Barro and Lee find returns about 12% for an additional year of schooling (using macro data) while the micro data yields an overall average return about 10%. However, the differences are substantial when comparing regions and ricer vs. poorer countries. Specifically Sub-Saharan Africa and Latin America are estimated to have the largest returns (about 12%) using micro data, while the macro results shows the lowest returns in these regions (just below 7%).

One possible explanation of the discrepancy is that education in some developing countries does not lead to increased productivity; while at the same time the education induced wage differences do not reflect productivity differences. Specifically, one could assume that tertiary education leads to employment in the public sector, with a high wage, while such work does not increase overall productivity in the country.

B3: Please explain how Nicolai Kaarsen (Cross-country differences in the quality of schooling. Journal of Development Economics, 107, 215-224. 2014) incorporates the quality of schooling into a development accounting exercise and describe how this change in the accounting affects the results, relative to an accounting that does not include quality of schooling.

Nicolai Kaarsen use TIMSS (Trends in International Mathematics and Science Study) test score results to construct a country specific measure of the quality of schooling. He assumes test scores (T) are related to years of schooling (s) and the quality of schooling as follows for test type k in country i at class level s in year t:

$$T_{k,i,s,t} = \beta_k + \gamma_k ln(s \times q_i),$$

The outcome is a set of estimates (qi) for the quality of school years as a fraction of a school year in the US (q_i).

When Kaarsen compares the importance of schooling in “explaning” variation in GDP per worker, he finds that including the quality of schooling, the variation in schooling increases greatly and, further, the fraction of income differences explained by the developing accounting rises substantially when education quality is included. The increase is around 22 percentage points.

Problem C

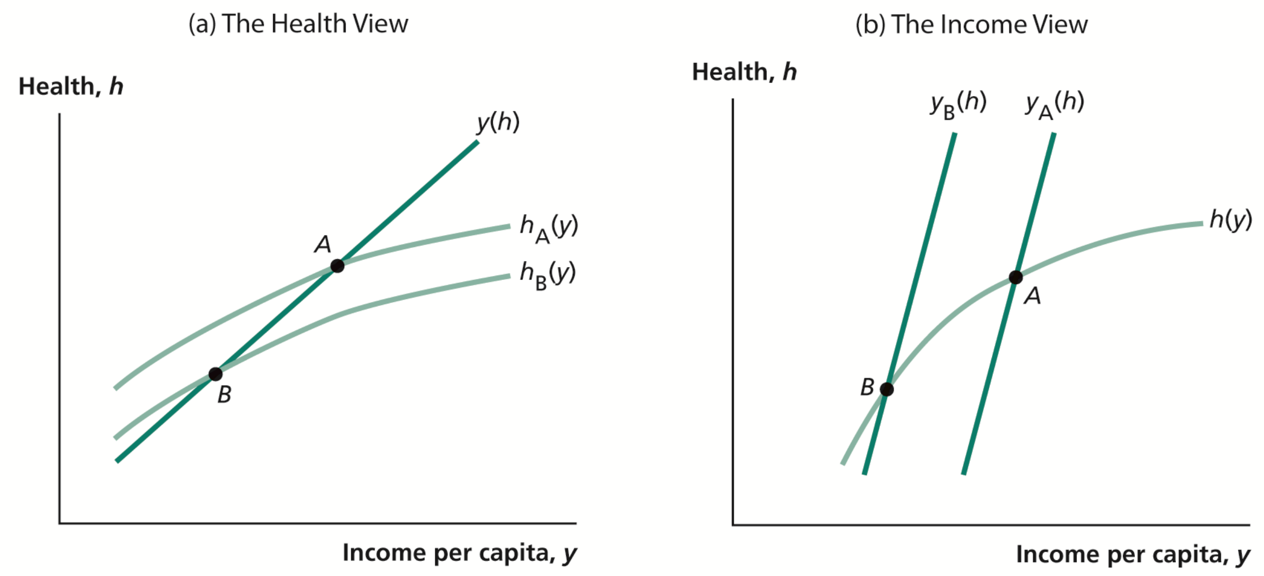
Climate may influence long-run development outcomes in a variety of ways.

C1: Please, provide a hypothesis of why climate may affect long-run development via institutional developments and how tests have been constructed to test the hypothesis.

This question draws on Alsan (2015, AER). Alsan focuses on the long-run impact of the Tse-Tse Fly, which can only survive under very specific climatic conditions. The hypothesis runs as follows. The Tse-Tse fly increases the mortality of both humans (who develop sleeping sickness) as well as draft animals. Alsan argues that this has made intensive farming difficult to attain in Africa (which is the only continent on which the Tse-Tse fly is found). As a result, early population densities where low, which has prevented political centralization in the pre-colonial period. Since early political institutions are still affecting outcomes (and besides may have made colonialization more likely) there is a link between climatic preconditions and long-run outcomes via pre-colonial institutions. Alsan demonstrates empirically the viability of the individual parts of the hypothesis using cross-sectional data across ethnic societies within sub-saharand africa. A particular test worth highlighting is that Alsan can show that the precise climatic conditions for the Tse-Tse fly (“Tse-Tse suitability”) only seems to work within Africa (and not on other continents). This is an important falsification test in that the Tse-Tse fly is ONLY found in Africa.

C2: Explain how the answer to Q1 relates to the so-called “income view” on health-income differences across countries. (*Hint*: you may wish to use a diagram drawn in (h,y) space, involving a schedule labeled y(h) and one labelled h(y), to structure your reply).

The figure below (from Weil) illustrates two fundamental views on how to think about differences in prosperity and health. Both figures involve a $y(h)$ schedule, which asserts that better health is associated with better economic outcomes, and a $h(y)$ schedule, which asserts that higher prosperity allow for better health outcomes. The former schedule, then, has e.g. levels of physical capital, schooling and TFP as parametrically given, whereas the latter takes the ambient mortality environment as given. The income view asserts that MOST of the differences in income and health are due to differences in the $y(h)$ schedule. A particular example could be Alsan’s theory, discussed above, which asserts that disease environment changes institutions and ultimately prosperity (at the proximate level via shifts in e.g. TFP). While the Tse Tse fly inevitably also affects the h(y) schedule the idea would be that the quantitative significance of such shifts, relative to the institutionally-induced shifts in y(h) are small.



C3: What is the "health view" on health-income differences across countries?

The health view asserts that differences across countries in the ambient mortality (or mobidity) environment is at the root of differences both in mortality and prosperity. Again, this view does not deny that the $y(h)$ may shift, but suggests that shifts in $h(y)$ are quantitatively more important. A natural example would be differences in disease ecology with respect to Malaria: malaria suitability both reduces health directly and income indirectly (via health). Another example that has been discussed at the lectures is Andersen, Dalgaard and Selaya (2016), which suggest that differences in disease ecology with respect to eye diseases may have prompted differences in long-run development outcomes.

C4: A reason why health may influence productivity is simply that healthier individuals can exert more on-the-job effort. (a) Explain how one may obtain a measure of health capital; (b) how to use it to assess the economic importance of health by way of development accounting and (c) how big a fraction of existing worldwide differences in labor productivity that can be accounted for differences in health.

This draws on Shastry and Weil (2003). The student should explain that the stock of health can be calibrated as exp (ϕ*z) , where *z* is average height in the population and the labor force and ϕ is the return to health, which derives from a "health augmented" Mincer regression. The more explicit the student is on this part the better. The logic of using average height as indicator (accumulated health shocks) should be mentioned, and the student should explicitly detail how (using a standard Cobb-Douglas production function) one can obtain the contribution of health to income differences (provided one has data on GDP, labor force, schooling, physical capital and TFP – the residual). Shastry and Weil (2003) finds that about 1/5 of total labor productivity differences can be attributed to the direct effect of health (bear in mind that indirect effects, via savings say, are "closed down").