Written Exam at the Department of Economics summer 2019

Development Economics

Final Exam

15. August 2019

(3-hour closed book exam)

Suggested answers

This exam question consists of 4 pages in total

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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. Please explain briefly the difference between exchange rate conversion and PPP conversion of GDP.

   This is explained in PRLB, chapter 1+2. The former provides the answer to the question: how many units of a particular currency (say, US$) can country x's GDP be exchanged into? The latter provides the answer to the question: how many units of goods and services can you command if you have country x's GDP. In other words, it provides a measure of the purchasing power of the attained local GDP. Naturally, only the latter is useful in the context of international comparisons.

2. Please explain why global poverty is measured by the PPP $1.90-a-day line and describe, briefly, how it was constructed.

   This is explained in Ravallion (1998) and Allen (2017). All countries with World Bank type household surveys have their own national poverty line, based on the cost of basic needs (CBN), expressed in the national currencies. PPP conversion factors for a wide range of countries makes comparisons of poverty possible. Such comparisons show that national poverty lines do not collapse to a single line, even when using the PPP-dollar. Hence, poverty measurements are not consistent across countries. World Bank economists (Ravallion, Chen and Sangraula) have estimated "global poverty lines" using 2005-PPP data and poverty lines from 75 developing countries. A $1.25 per day poverty line is the average poverty line for the 15 poorest countries in the sample. Hence, it represents extreme poverty across countries. The poverty lines of the 15 countries in their own currencies were raised with national price indices to 2011 values and then converted to US dollars with PPP exchange rates computed from the 2011 round of the International Comparison Program (ICP2011) price data. The average came to US$1.88, which was rounded up to give the $1.90-a-day line.

3. Please explain briefly, why intra-household inequality may be a source of bias in estimates of inequality and state if the bias is positive or negative.

   This is explained in Ravallion (2018). Household surveys assume equality of income and consumption within households (household income is divided by the number of household members to get per capita income/consumption). Ravallion states that this is "almost certainly wrong because, and the direction of bias is clear: we will underestimate overall inequality".

4. Please explain what is meant by a "dual economy"

   A dual economy is characterized by the existence of two distinct types of economic segments: A modern segment—often seen as a modern manufacturing sector with profit maximizing firms—and a traditional segment—often seen as the agricultural sector with low productivity and subsistence wages.

5. What are the possible channels through which growth reduces fertility?

   Weil (Section 4.4) discusses four possible channels. (i) Mortality: Declining mortality reduces

the desired family size because it is not family size per se that matters but the probability of having a surviving son. As mortality falls, it becomes possible for families to produce the same number of surviving adults with lower fertility. (ii) Income growth gives rise to both income and a substitution effects. The income effect gives rise to more children, while the substitution effect (when the wage is high, time demanding children are relatively more expensive) leads to less children. We may assume that income effect dominates at low levels of income while the substitution effect dominates at high levels of income. (iii) Resource flows between parents and children: As a country develops, the economic benefits of children tend to fall while the cost of raising children rises. (iv) Quality-Quantity trade-offs. High income may increase the return to skill investments (Human capital). This may induce a substitution from quantity (many children) to quality (few, but well educated children).

6. In "Why doesn't capital flow to poor countries?" Robert Lucas proposes an answer to the question he raises. Please, explain what his answer is.

   Robert Lucas proposes that differences in human capital is the main reason why capital doesn't flow from rich to poor countries. Lucas manages to show that the real rate of return differences disappear when one takes human capital into account, while admitting sizable externalities.

7. Please explain how donations of food to a country can hurt local farmers by undermining the incentives for them to produce food.

   This is explained in PRLB (Box 14-5, p. 528). If all food is produced locally (no imports), then an increase in food from aid donations can shift out the supply curve for food and drive down food prices, benefitting consumers but hurting farmers. This is shown in the panel (a) of Figure 14-6, given below.

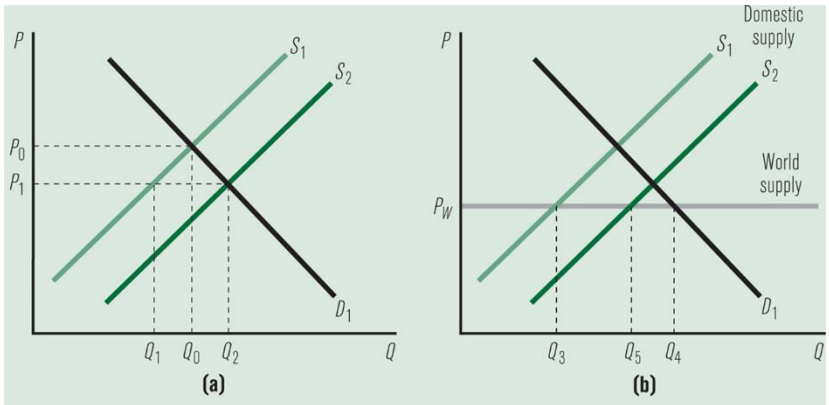

FIGURE 14-6 Food Aid, Prices, and Production

(a) Food aid and production in the absence of imports: Food aid lowers prices, benefiting consumers but displacing local production. (b) Food aid and production with imports: Food aid adds to the total supply without affecting prices or displacing production.

Problem B: Development Accounting

1. Assuming final goods are produced according to the Cobb-Douglas production function $Y = AK^{\alpha}(hL)^{1-\alpha}$, illustrate how development accounting decomposes relative income differences into factors of production and productivity and discuss the relative order of magnitude observed across countries using *two* different development accounting formulations (say a "short run" and "steady state" type decomposition).

   ANSWER: Development accounting is explained in Weil section 7.2. Starting from the Cobb-Douglas production function in per worker terms $(y = Ak^{\alpha}h^{1-\alpha}, y = Y/L, k = K/L)$ the productivity in two countries can be compared by creating the ratio of output in country 1 relative to the output in country 2:

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

   This equation makes concrete the idea that countries can differ in their levels of output because of differences in productivity, differences factor accumulation, or both. Development accounting using the above equation asks the hypothetical question: how much of the relative difference in output per capita in country 1 relative to country 2 can be attributed to one of the following factors: physical capital per capita, human capital per capita, or productivity, holding the other two factors fixed. Using this decomposition, Weil finds that 53 percent of the variation in (log) output per capita across countries can be accounted for by variation in productivity leaving 47 percent to the factors of production.

   One objection to this accounting exercise is that physical capital per capita, according to the Solow model, is expected to endogenously increase in response to increases in human capital or technology. Therefore, an alternative formulation of the accounting is sometimes used, for example in Jerzmanowski (2007, p. 2089) and Shastry and Weil (2003, p. 390). Specifically, the production function (in per capita terms) is rewritten to have the capital-output ratio on the rhs (the capital-output ratio is constant in a Solow-type steady state):

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

   The development accounting is as above with productivity, the capital-output ratio and human capital

$$\frac{y_1}{y_2} = \left(\frac{A_1}{A_2} \right)^{1/(1-\alpha)} \times \left(\frac{K_1/Y_1}{K_2/Y_2} \right)^{\alpha/(1-\alpha)} \times \frac{h_1}{h_2}$$

   Here, the hypothetical question is how much of the relative difference in output per capita is accounted for by relative differences in human capital, the capital output ratio, and productivity. This question is compatible with the steady state of the Solow growth model in which the level of human capital or productivity has no direct effect on the steady state capital-output ratio. The bigger exponents on productivity (i.e., $1/(1-\alpha)$ instead of 1) and on human capital (1 rather than

$1-\alpha$) reflect the impact of these variables on output both directly and indirectly through capital per capita. Results in Shastry and Weil (2003) shows that productivity accounts for just below 60 percent using the "steady state" type decomposition.

2. 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. This gives rise to changes in the development accounting as shown in his Table 4, reproduced below (where $yKH = k^{a}h^{1-\alpha}$ is GDP per capita as predicted by the pure input factors model. Please explain the results given in the first five rows of the Table.

Table 4
Decomposition of income differences, 72 countries.

Includes quality of human capital:	No	Yes
	(1)	(2)
Var(lny)	0.84	0.84
Var(lnh)	0.05	0.27
Var(lnyKH)	0.21	0.39
Var(lnh)/Var(lny)	0.06	0.32
$\text{success1} = \text{Var}(\ln y_{KH})/\text{Var}(\ln y)$	0.25	0.47
$y90/yi0$	10.55	10.55
$h90/hi0$	1.74	3.30
$yKH,90/yKH,10$	3.12	5.26
$(h90/h10)/(y90/y10)$	0.16	0.31
success2 = (yKH,90/yKH,i0)/(y90/yi0)	0.30	0.50

Notes: y is GDP per capita, h is human capital, y_{KH} is GDP per capita predicted by the factors-only model. Subscript 90 indicates the 90% percentile and subscript 10 indicates the 10% percentile. In the first column, human capital is computed under the assumption that there are no differences in education quality. The second column takes differences in education quality into account. See the main text for details on how the human capital stocks are constructed.

ANSWER: Kaarsen use the first version of the development accounting formulation and look at the variance in the log of output per capita:

$$\text{var}\left(\ln(y)\right) = \text{var}\left(\ln(A)\right) + \text{var}\left(\alpha\log(k) + (1-\alpha)\log h\right) + 2\,\text{cov}\left[\ln(A), \left(\alpha\log(k) + (1-\alpha)\log h\right)\right]$$

The first row in Table 4 gives the variance in the log of output per capita across the countries in the sample. The second row gives the variance in the log of human capital, without and with his adjustment for the quality of schooling. The third row gives the variance in the log of the factors of production, without and with his quality adjustment. The fourth row is the ratio of the variance of (log) human capital to the variance of (log) output per capita while the fifth row is the ratio of the variances of factors of production to output per capita. The table shows that when quality differences in schooling are included in the decomposition the variation on human capital across countries increases fivefold and the fraction of the variation in output per capita that can be attributed to factors of production doubles (from 0.25 to 0.47 in Kaarsen's sample of countries).

3. Illustrate how productivity can be further decomposed into technology and efficiency and consider Table 5 from Jerzmanowski (2007), given below, in which Jerzmanowski uses the steady-state type development accounting to decompose the cross-country variation in (log)

output per worker. Please explain the results given the Table.

Table 5
Fraction of cross-country variation in output per worker accounted for by variation in available technology (T), efficiency (E), and accumulated factors (F)

Variation in output per worker explained by	1995 (%)	1985 (%)	1960 (%)
Efficiency	43	41	28
Technology	26	23	27
Factors	31	36	45

ANSWER: The level of productivity (A) can be thought of as being composed of technology (T) and efficiency (E), such that

$$A = T \times E$$

Jerzmanowski uses a non-parametric analysis coupled with the standard Cobb-Douglas production function to compute levels of technology (T) and levels of efficiency (E) relative to USA. Subsequently, he applies the steady state type development accounting decomposition to compute the relative importance of accumulated factors (physical capital and human capital), technology and efficiency. Results of the variance decomposition for the three years 1960, 1985 and 1995 are given in the table. The table shows that in 1995 69 percent of the cross-country variance in (log) output is accounted for by variation in productivity. This fraction is subsequently split into 43 percent accounted for by variation in efficiency and 26 percent due to technology. The fraction of the variation due to efficiency has been increasing over time, while the fraction due to technology has been roughly constant and the fraction due to factors of production has decreased. The results suggest that both inefficiency and appropriate technology theories appear to be relevant for understanding income differences. However, the decomposition also shows that inefficiency appears to be a more important source of income differences and that its importance has increased since 1960.

1. Finally, consider Figure 4 and Figure 5 in Jerzmanoswski (2007), given below.
Please explain why it may be problematic for developing countries that the technology frontier T(K/H) as estimated by Jerzamnowski is only increasing over time for fairly high levels of the ratio of physical capital to human capital.

ANSWER: First it should be noticed how all developing countries have low efficiency and low levels of techoology (i.e., they are in the south-west corner in Figure 4). Second, Jerzmanowski (p. 2100) states “Fig. 5 shows that technological change between 1960 and 1995 shifted the frontier up unevenly. In particular, the lower portions of the frontier remained virtually unchanged, while the most significant technological progress took place in the region where developed countries operate.” “Overall, Fig. 5 suggests that technological divergence of the sort predicted by appropriate technology theories is taking place.” And finally: “[T]he finding of technological divergence seems to support the theories of appropriate technology, which hold

that poor countries are unable to reap benefits of the innovations in leader countries despite technology's public good nature."

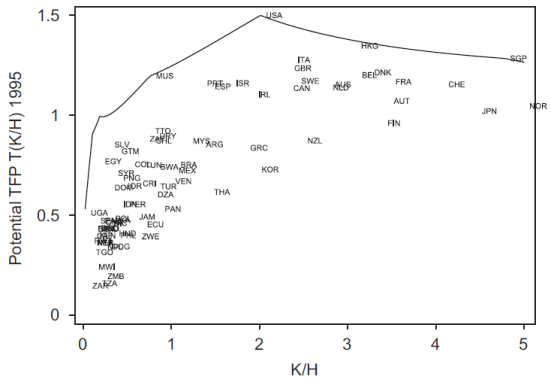

Fig. 4. Technology frontier: 1995.

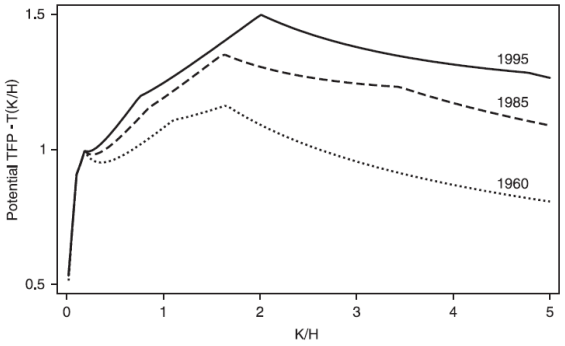

Fig. 5. Shifts of the technology frontier $T(k/h)$ 1960–1995.

Problem C: Long-run Development

1. Sub-Saharan Africa (SSA) is one of the most impoverished areas on the planet. It is also an area characterized by relatively poor health. Please, explain what should mainly be the cause of poor health and income under the "income view" and the "health view", respectively.

   ANSWER: The point of departure of the discussion is a diagram drawn in health/income space. Two schedules illustrate, respectively, income as a function of health ("income curve") and health as a function of income ("health curve"). Assume the SSA outcome can be seen as an intersection point between the two curves (an illustration of the figure is inserted here). "The Income View" asserts that a low position of the income curve is causing simultaneously low prosperity and low income. Possible driving forces are thus factors that lead to low income conditional on health status of the population such as poor institutions. The "Health view" asserts that low position of the health curve leads to poor outcomes in health and wealth. That is, this is driven by factors that lead to poor health outcomes conditional on income, such as the disease environment (e.g., geography).

2. Slavery has most likely had a detrimental impact on long-run development in SSA. (i) Please, explain how the transatlantic slave trade might have an impact on economic development today. (ii) What evidence supports the mechanism you have just outlined? (iii) Does the "slavery mechanism'' support the "income view" or the "health view" discussed in Question C1 above?

   ANSWER: (i) The transatlantic slave trade arguably lead to the creation of a culture of low trust in other people, including friends, neighbors and relatives. The key reason is that many people were kidnapped by neighbors or even relatives to be turned over to Westerners for export. With time this state of affairs, arguably, led to the development of the rule of thumb that people cannot be trusted. From an economic point of view, low trust is problematic for a variety of reasons. Most fundamentally, it can be expected to increase transactions costs associated with economic activity. When low trust also extends to political representatives, it may reduce the

likelihood that public good provision – which often involves upfront costs but delayed benefits—are less likely to be supplied. (ii) In the article discussed at the lectures by Nathan Nunn and Leonard Wantchekonen, the authors examine trust scores from Afrobarometer at the individual level, regressing it on slave exports (measured in a variety of ways) from the ethnic group to which the individual belong. The correlation is strong, and supports the above argument. But identification is obviously hard. A key problem lies in distinguishing between low trust resulting from poor institutions (caused by slavery, say) from an impact of slavery on trust that is *intrinsic* to the individual and thus captures the rule of thumb-type behavior discussed above. In this regard the authors exploit the fact that many people today do not reside in the same area as the ethnic group that the individual belongs to. This makes it possible to examine the influence from ancestry on trust, controlling for local environment. Another concern is that of reverse causality: it is possible that more people were exported from areas where people *ex ante* did not trust each other? To this end the authors explore an IV solution, using distance from coast of the ethnic group. The logic being that slaves were extracted from the coast, and consequently that ethnic groups close to the coast are more likely to be affected. A placebo test, whereby distance to coast is regressed on trust *outside* Africa supports the exclusion restriction (as do a variety of controls designed to control for e.g. occupational drives of trust – fishing communities, for example, exhibit higher trust). In the end it seems a strong case can be made that slavery had a deleterious effect on trust on the (Sub-Saharan) African continent. (iii) Since trust can be expected to lower output for health given, the present mechanism can be said to support the "income view". This is due to the fact that slavery may have influenced trust that increases transaction costs that therefore economic activity, for health given. In addition, to the extent that institutions were affected in an adverse fashion this too will work to lower income.

3. The TseTse fly has been singled out as a factor hampering development on the (Sub-Saharan) African continent. (i) Please, explain how the TseTse fly may have influenced long-run development in Africa. (ii) How can one test the mechanism you have just outlined? (iii) Does the "TseTse fly mechanism'' support the "income view" or the "health view" discussed in Question C1 above?

   ANSWER. (i) The work by Alsan suggests that the TseTse fly influenced long-run development in Africa by hampering intensive farming. This is due to the fact that the TseTse fly not only affects humans, but also large draft animals. As a result, this dampened population density, which historically has worked to hamper the development of complex political institutions, Alsan argues. Aside from the fact that the Neolithic itself is delayed on the African continent, for reasons espoused by Jared Diamond, the existence of the TseTse futher delayed the rise of complex societies in Africa, slowing down the speed of development. (ii) Alsan develops a TseTse suitability index, that is an index which captures how well suited local conditions are for the survival of the insect. In practice this involves non-linear transformations of temperature and humidity weighted together. Alsan then explores whether the index correlated with each of the factors discussed above: the use of draft animals in agriculture, population density and complex political hierarchies. The non-linearity of the index with respect to temperature and precipitation means that all regressions can be performed with linear control for these factors (in addition to a host of other factors). Perhaps the most persuasive support in favor of identification is that

Alsan can show her index *only* influences development outcomes in Africa. Since the TseTse fly is only found in Africa this supports identification. (iii) At first it would appear that the mechanism should belong to the health view. However, since the mechanism works through institutions it should be categorized as a mechanism supporting the income view also.

4. Another factor, which has been singled out as influencing long-run development, is the intensity of ultraviolet radiation (UV-R). (i) Please, explain why UV-R may have influenced long-run development and which places on the planet are most likely to have been affected by the adverse effects of UV-R. (ii) How can one test the influence of UV-R on long-run development? (iii) Does the UV-R mechanism support the "health view" or the "income view"?

   ANSWER. A reason forwarded by Andersen et al is that UV-R influences the incidence of eye diseases, which has hampered the return on human capital accumulation historically. For instance, using incidence rates of severe cataracts the authors show that regions with high UV-R (in particular locations close to the equator, and at higher altitudes) has experienced around ten years lower work-life expectancy in skilled work, compared with low U-R regions. By reducing the inherent return to skill accumulation it may have contributed to a delayed demographic transition and onset of modern growth. As a result, high and low UV-R regions would diverge in prosperity. (ii) the intensity of (average) UV-R can be obtained at high levels of geographic resolution. This makes it possible to test a reduced form link both at the country and sub-regional level (for instance, and 1x1 decimal degree resolution). Since reverse causality can never been an issue in the present context, omitted variables is the key challenge to identification. The authors therefore rigorously control for determinants of UV-R (latitude, altitude) as well as other geographic charactaristics that may be correlated (spuriously) with UV-R. The authors also explore the UV-R development link intertemporally. If the UV-R mechanism works trough a differentiated timing of the take-off, there should be little association to comparative development prior to the take-off – that is, during the period before (say) 1800. In addition, if the link between UV-R and development is channeled through the take-off – which involves the demographic transition – there should be no link in places where the demographic transition did not occur through individual choice; only where it was a result of individual choice. In China the demographic transition was essentially orchestrated by the government, in contrast to the US. Accordingly, there should be no influence of UV-R on development (conditional on controls – cf above) *within* China where it should be found within the US. This is what the data shows. (iii) Since the UV-mechanism involves disease ecology, and thus suggests lower health for given income, it can be argued to support the "health view".