Written Exam at the Department of Economics summer 2019

Development Economics

Model answer

31. May 2019

(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. Please give some characteristics of the world's poor people (a global poverty profile).
    A global poverty profile is sketched in PRLB. Five characteristics are emphasized:
    a. Poverty is rural: Rural poverty is higher than urban—and the rural population is larger than the urban
    b. Poor people are primarily engaged in agriculture and associated activities
    c. People with no, or low, education have much higher poverty rates than people with more education—and the population with no and low education is large
    d. Ethnic minorities and indigenous people have very high poverty rates in Latin America and Asia—but the populations are often small
    e. Female headed households have higher poverty rates than male headed households--but there are not that many female headed households compared to male headed households

2. Please define and explain growth accounting
    Growth accounting is defined and explained in Weil section 7.2. Starting from a Cobb-Douglas macro production function in per worker terms $y = Ak^{\alpha}h^{1-\alpha}$ we take the of the log-transform derivative with respect to time to get $\hat{y} = \hat{A} + \alpha\hat{k} + (1-\alpha)\hat{h}$, where hats indicate growth rates. This shows that the growth rate of output is the sum of the growth rate of productivity ($\hat{A}$) and the growth rate of factors of production ($\alpha\hat{k} + (1-\alpha)\hat{h}$). We use this to get an estimate of the growth rate of productivity (the Solow residual):
    growth rate of productivity = growth rate of output – growth rate of factors of production
    ($\hat{A} = \hat{y} - [\alpha\hat{k} + (1-\alpha)\hat{h}]$). "The technique for deriving the growth rate of productivity is called growth accounting." (Weil p. 213).

3. Please define and explain two obstacles to international transfer of technology.
    The obstacles are discussed in Weil, Section 8.4.
    a) Appropriate technology: Technology is created/developed in the rich countries—hence it is appropriate for the existing rich country production mode and level, it is not necessarily appropriate for the poor country production mode and level (capital-bias, skill-bias)
    b) Tacit knowledge: Use of new technology requires both codified knowledge (blueprints) and often tacit (implicit, unstated) knowledge. Rich countries can only transfer the codified knowledge

4. Please explain briefly how Gollin, Hansen and Wingender (2016) estimates the total impact of the green revolution on GDP per capita.
    Gollin, Hansen and Wingender estimates a cross-country regression in which GDP per capita across 85 countries is regressed on the harvested area of modern varieties (MV) of ten crops relative to the total harvested area of the ten crops (in each country)—this fraction is denoted the adoption rate. To overcome simultaneity bias the authors use the predicted adoption rate for MVs at country level based on agro-ecological zones as instrument for the actual adoption rates.

5. What are population "optimists'' and population "pessimists"? Provide a theoretical argument in favor of either view.

This is explained in PRLB (Chapter 7). Population pessimists perceive population growth as harmful to economic development. In contrast population optimists view population growth as having the potential to increase factor productivity. The theoretical arguments for the pessimists are (1) capital dilution; the investment needed to provide a constant amount of capital per worker is higher with high population growth; (2) the population growth also dilutes the human capital (less education per child) and (3) the dependency ratio is higher resulting in lower income per capita for and lower saving at any given level of income. The Malthus arguments with positive and negative feed-backs may also be mentioned. The main theoretical argument for the optimists is that population growth has the potential for increasing factor productivity. This may come about by (1) economies of scale, say in infrastructure and public service; (2) technological change, because of larger populations having more entrepreneurs and other creators.

6. What was "The Brady Plan"?

The Brady Plan is discussed in PRLB (Chapter 13). The Brady plan was an attempt (largely successful) in dealing with the 1980s debt crisis; especially for Latin America. Beginning in 1989 it consisted in a case-by-case renegotiation of debts, involving a range of options including reductions in the face value of debts, lower interest rates, provding new loans etc. The debtor countries issued new bonds, called Brady bonds, to banks that held debt to replace the old debt. The extent of debt relief varied from country to country, but in some instances it was quite extensive.

7. The Berlin conference was instrumental in the creation of modern borders around contemporary African countries. (i) What is the problem with contemporary borders? (ii) How might it affect long run economic growth? Please, explain.

(i) The problem with current borders is discussed in Michalopoulos and Papaioannou (2016, AER) (MP). The key issue with current borders is their arbitrariness. In particular, the largely randomess of the borders means that many ethnic groups are partitioned between different countries. While this mattered little on the ground during colonial times, it has arguably had considerable effect in the post independence era. (ii) Areas where ethnic groups are seperated often become hotbeds of irredentism, which can lead to conflict (and example would be the partitioning of Somalis between Italian Somaliland, Southern Ethiopia, Northern Keyna, French Somaliland-Djibouiti and British Somaliland). Partitioned ethnic groups are able to seek shelter among tribesmen in neigbouring regions, but also obtain support during conflict in terms of material. In fact, in the article by MP the author's document that neighbor countries often use border areas dominated by partitioned ethnic groups are "beachheads" during conflict. Perhaps due to the expectation of potential lack of loyalty, ethnic groups in border regions are often discriminated by central governments (property confiscation, high taxation etc). The bottom line is that the partitioning of ethnic groups has led to conflict, which (aside from reducing well-being in itself) has served to curb economic growth.

Problem B: Inequality and Development

1. Please explain how data for measurement of inequality is gathered in the developing world and discuss possible data problems.
2. Please give a brief summary of the main theories explaining how income inequality affects economic growth.
3. The table below (covering 2 pages) is Table 4 from Berg, Ostry, Tsangarides and Yakshilikov,"Redistribution, inequality, and growth: new evidence", J Econ Growth (2018) 23:259–305.
   Please relate the results in the table to the main theories given in Problem B2, and discuss the extent to which the theories are supported or refuted by the empirical findings.

Table 4 Transmission channels of inequality and redistribution. *Source*: See notes to Table 2

Variables	Effects on growth, adding channels						Effect of inequality and redistribution on the channels						Growth
	(1)	(2)	(3)	(4)	(5)	(6)	(7) Investment	(8) Population	(9) Education	(10) Life expectancy	(11) Fertility	(12) Polity	(13) Full specification
Log(initial income)	−0.0070*	−0.0068**	−0.0104**	−0.0130**	−0.0228***	−0.0237***	0.1130**	−0.0615***	0.2623***	0.0694***	−0.2555***	0.0182**	−0.0031
	(0.0035)	(0.0029)	(0.0049)	(0.0055)	(0.0058)	(0.0062)	(0.0495)	(0.0181)	(0.0455)	(0.0059)	(0.0350)	(0.0077)	(0.0034)
Net inequality	−0.0853**	−0.0672**	−0.0680**	−0.0776***	0.0228	0.0213	−0.0363	0.6802***	−2.5477***	−0.2050***	1.7899***	−0.2342***	−0.1135***
	(0.0361)	(0.0335)	(0.0302)	(0.0256)	(0.0279)	(0.0416)	(0.5787)	(0.2348)	(0.6882)	(0.0638)	(0.3389)	(0.0743)	(0.0425)
Redistribution	0.0357	0.0325	0.0447	0.0505	0.0420	0.0255	−0.6635	−0.1044	−1.5543***	−0.1027	0.1271	−0.1333	−0.0276
	(0.0406)	(0.0393)	(0.0541)	(0.0505)	(0.0505)	(0.0608)	(0.6580)	(0.3180)	(0.5039)	(0.0835)	(0.4831)	(0.1110)	(0.0627)
Log(investment)	0.0260*	0.0223**	0.0267***	0.0207**	0.0415***	0.0401***							
	(0.0147)	(0.0087)	(0.0093)	(0.0094)	(0.0110)	(0.0107)							
Log(population growth)		−0.0206	−0.0133	−0.0007	0.0169	0.0019							
		(0.0276)	(0.0212)	(0.0140)	(0.0131)	(0.0062)							
Log(total education years)			0.0122	0.0046	0.0179	0.0185*							
			(0.0096)	(0.0105)	(0.0117)	(0.0105)							
Life expectancy				0.0810	−0.0848	−0.0446							
				(0.0628)	(0.0670)	(0.0913)							
Log(fertility)					−0.0633***	−0.0593***							
					(0.0159)	(0.0175)							
Polity						−0.0405							
						(0.0656)							
Residual of Log(investment)													0.0401***
													(0.0107)

Table 4 continued

Variables	Effects on growth, adding channels						Effect of inequality and redistribution on the channels						Growth
	(1)	(2)	(3)	(4)	(5)	(6)	(7) Investment	(8) Population	(9) Education	(10) Life expectancy	(11) Fertility	(12) Polity	(13) Full specification
Residual of Log(population growth)													0.0019
													(0.0062)
Residual of Log(total education years)													0.0185*
													(0.0105)
Residual of life expectancy													−0.0446
													(0.0913)
Residual of log(fertility)													−0.0593***
													(0.0175)
Residual of polity													−0.0405
													(0.0656)
Constant	0.0245	0.0628	0.0485	0.0285	−0.1413**	−0.1071**	2.2233***	2.1963***	0.2456	0.1239**	−1.6924***	0.0064	0.0853**
	(0.0408)	(0.0650)	(0.0589)	(0.0510)	(0.0591)	(0.0487)	(0.4278)	(0.2343)	(0.5435)	(0.0571)	(0.3667)	(0.0779)	(0.0346)
Observations	656	656	656	656	656	656	656	656	656	656	656	656	656
Number of groups	88	88	88	88	88	88	88	88	88	88	88	88	88
Number of instruments	93	102	88	98	98	108	108	66	58	99	99	99	108
AR1 test (p values)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.7789	0.2878	0.0008	0.0000	0.0000	0.5046	0.0000
AR2 test (p values)	0.5533	0.3761	0.4158	0.5819	0.8151	0.5442	0.0108	0.5049	0.1504	0.6189	0.1977	0.2640	0.5442
Hansen test of joint instrument validity (p values)	0.4947	0.8599	0.4867	0.7757	0.7450	0.8113	0.8480	0.2911	0.2027	0.7724	0.7386	0.5887	0.8113

System GMM estimation. Robust standard errors in brackets where *, **, and *** indicate statistical significance at the 10, 5 and 1% levels, respectively

Solution guide.
1. The data gathering and data issues are discussed in Ravallion (2018), section 3. Data is collected using household surveys. Ravallion writes "[A]lmost all household surveys use personal interviews. The household data refer to either consumption expenditure or disposable income, as reported by respondents for stipulated (often rather short) recall periods. Standard practice by statistics offices is to use a survey instrument that can cover all income sources and/or market goods and services consumed, including imputed values for consumption from own production, as is important for farm households." The main problems listed in sections 3 of Ravallion (2018) are
    a. Selective non-compliance by rich households and/or under-reporting of consumption and income by rich households. The effect of such problems are theoretically uncertain, but in practice they seem to be associated with under estimation of the inequality (a negative bias).
    b. 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, and the direction of bias is clear: we will underestimate overall inequality".
    c. Finally, there is an issue with prices. "Differences in prices between countries are dealt with using purchasing power parity (PPP) rates of exchange. Since price levels tend to be higher in richer countries (…), using PPPs rather than official exchange rates tends to reduce the level of inequality *between* countries." Further, "[I]t is not common to include deflators for geographic cost-of-living differences within counties. Within-country inequality is likely to be *overestimated* due to this omission." (Students need not know the within country price-problem).
2. The links between inequality and economic growth are described in PRLB chapter 6, Weil chapter 13 and Berg et al. (2018). There are 5 explicit links from inequality to economic growth of which only 4 are covered in detail in PRLB and Weil:
    a. Following Weil (p. 400), more inequality leads to a higher level of physical capital accumulation. The reason is that more inequality leads to higher total savings because individuals' savings rates tend to rise with income. Hence, this link relates high inequality to high growth.
    b. A more unequal distribution of income leads to lower human capital accumulation. An important reason is that human capital is embodied (installed in a specific person). Consequently, human capital cannot be used as collateral, leading to a missing (financial) capital market. Therefore, poor people have to fund educational choices out of retained earnings, wealth or abstention from currently productive work. Because they are poor the marginal cost of doing so may be prohibitively high, exceeding the marginal return. In the end, poorer people underinvest in human capital, leading to lower total human capital accumulation in economies with more unequal income distribution. This link relates high inequality to low growth.
    c. A more unequal distribution of income may also lead to crime and risk of violent conflicts (sociopolitical unrest). The risk of destruction of output and loss of ownership of capital implies lower expected return on investment. This leads to lower capital accumulation even without actual conflict. This link relates high inequality to low growth.

    d. In Weil p. 404-405 it is explained how inequality leads to a desire for redistribution. This comes about because an individual with pretax income above the mean would prefer a redistributive tax rate of zero while individuals with pretax income below the mean will want a positive tax rate. The specific desired tax rate will be higher for individuals with lower pretax income. The tax rate in a country is assumed determined by a political process involving voting. Thus, the tax rate in the country will be the rate that is optimal for the voter with the median level of pretax income (the median voter). A higher tax rate may have negative effects on economic growth for two reasons: (1) lower capital accumulation if taxes are imposed on the margin, and (2) lower efficiency, as explained in Weil p. 406. The overall outcome of the model with political redistribution is that higher pretax inequality leads to lower economic growth.

    e. Berg et al. (2018) mentions a link between inequality and growth through an effect of inequality on fertility (the quality/quantity relation). This link relates high inequality to low growth. Students are not expected to explain this link as it is not well described in the texts.

3. Table 4 presents several sets of regressions of inequality (measured by the Gini-coefficient) on GDP growth (regressions (1)-(6)) and on the channels through which inequality is expected to affect growth (regressions (7)-(12)).

    a. Regression (1) estimates the impact of investment (investment/GDP) on growth, when also controlling for inequality and redistribution, while regression (7) estimates the impact of inequality and redistribution on investment. It is somewhat surprising that investment only has a weakly significant impact on growth (albeit the effect is more precisely estimated in regressions (2)-(6)). Further, inequality and redistribution does not appear to influence investment, whereby Berg et al. do not find support for the classical link given in B2a. Moreover, there is no support for the investment part of the redistribution link given in B2d. One explanation could be that the influences on capital accumulation (savings, political unrest and redistribution) cancel each other out in the sample.

    b. The human capital link is estimated in regressions (2), (9) and (10). Neither education nor life expectancy appear to have statistically significant effects on growth, conditional on inequality and redistribution. However, inequality has a statistically significant, negative impact on both education and life expectancy, leading Berg et al. to conclude that this is an important channel through which inequality affects growth.

    c. Berg et al. argue that they find some support for the socioeconomic unrest theory as inequality has a negative impact on political institutions (measured by the variable "polity"). However, polity appears not to have a statistically significant effect on growth. Hence, as for the human capital link, the first part of the link can be established, but the second part cannot—in the regressions presented in the paper.

    Overall, the empirical support for the individual theories linking inequality and growth is not as clear as one could wish for.

Problem C: Physical capital

1. How much of the observed variation in GDP per worker across the world can be attributed to differences in physical capital? (i) Please, explain how development accounting can provide an answer. Be as precise as you can. (ii) What is the typical ballpark answer?

2. In a closed economy setting, cross-country differences in capital stocks is due to savings. The reason is that total investments equal total savings by national accounts identity. In a setting where capital is freely mobile, this is no longer true. Hence, in a world characterized by well-functioning international capital markets low savings is less of an obstacle for poor countries in their quest to obtain nation-wide prosperity. Please, explain what, respectively, "The Feldstein-Horioka puzzle" and "The Lucas Paradox" are, and how they relate to the issue of how effective international capital markets are in allocating capital.

3. In a more recent contribution, Francesco Caselli and James Feyrer re-examine the efficiency of international capital markets. Please, describe their approach and their main findings.

4. Consider a small open economy, Assume international capital mobility is perfect. Can foreign aid, in the shape of a capital transfer, help increase GDP (per capita)? Please, explain why or why not.

5. What domestically enacted policies may increase the domestic capital stock and thereby the gross domestic product of a small open economy, when capital is internationally mobile?

Solution guide

1. (i) It is expected that the student provides a standard accounting expression such as
    $$y = A(\tfrac{K}{Y})^{\frac{a}{1-a}},$$
    where a is the share of capital in national accounts (naturally, using a formulation where K/Y enters is not essential; one where its K/L that enters the rhs is equally acceptable). Everything on the right hand side can be measured (albeit imperfectly) or determined as a residual. Taking logs and variances leaves you with
    $$var(lny) = var(lnA) + \left(\frac{a}{1-a}\right)^2 var\left(\ln\left(\frac{K}{Y}\right)\right) + 2cov(lnA, \ln(\frac{K}{Y}))$$
    As always it is not obvious how to deal with the covariance term. But assigning it evently to the two variance and dividing through by var(lny) provides a measure of the fraction of the total variation in GDP per worker (y) that can be accounted for by physical capital equipment. (ii) A standard ballpark figure is 20% (cf e.g. Shastry and Weil)

2. The Feldstein-Horioka puzzle is that there exist a very strong link, nearly 1:1, between domestic savings and domestic investments within the OECD area. Accordingly, despite the fact that capital can move across countries you see a pattern, which would fit a collection of closed economies. This finding suggests that international capital markets are not functioning very efficiently.

The Lucas paradox approaches a similar issue from a different angle. In essence Lucas starts by noting differences in capital per worker is quite large between rich and poor countries. If factor markets are competitive, to a first approximation, the real rate of return in a country should equal the marginal product of capital. In light of the vast differences in capital per worker, one would expect huge differences in rates of return between, say, the US and India, implying capital should flow from capital abundant US to India where capital is scarce. In practice, this does not happen. So why doesn't capital flow to poor countries? One possibility, of course, is that international capital markets are not functioning very well. That is, perhaps there are large frictions. Lucas, however, pursues a different idea. Namely, that the US is abundant in another production faction that is complementary to capital: human capital. In order to close the apparent gap in returns, based on observed differences in capital-labor ratios, however, Lucas have to assume sizeable human capital externalities, which are hard to validate independently empirically. Absent a good explanation, then, for observed capital (apparently in the opposite direction of where it should go based on theory), the Lucas paradox also suggests capital markets are not functioning very well.

3. C&F assume, like Lucas', that market are competitive. In contrast to Lucas, however, they allow investment goods and consumption goods to differ. As a result, the marginal product of capital is given by $MPK = \frac{P_I}{P_y}(r + d)$, where P_I is the investment price and P_y the price of output, r is the real rate of return and d is capital depreciation. To calibrate MPK, we observe that the share of capital in national accounts: $a = \frac{P_I(r+d)K}{P_yY} \leftrightarrow a\frac{Y}{K} = MPK$, where the last equality follows from using the FOC from profit maximization. Given data on Y,K and a, MPK can be calculated. Now, C&F observes that what matters to an investor is whether r is roughly equalized. This number can now be obtained from $MPK = \frac{P_I}{P_y}(r + d)$, conditional on data on the relative price of investment, MPK and the assumption that d is the same everywhere (which is an untested assumption that may or may not be accurate). It turns out that r is nearly the same across countries. This impression is further strengthened, when the authors allow the share of capital to capture the remuneration of physical as well as natural capital. That is, in practice a = (RK+rN)/P_YY, where N is the stock of natural capital (predominantly, land). Using this, along with data on r and N (from the World Bank) leads to a modified number for MPK and a modified calibrated r for each country. The main insight is, then, that while K/L is higher in richer countries, the relative price of investment is lower. Overall, the study suggests that international capital markets are fairly efficient. (Note: The use of mathematics is not required for full points).

4. C&F make the point that if international capital markets are well functioning an inflow of foreign aid will not matter much. The argument is (i) that aid can be viewed as a transfer of physical capital, and, (ii) that international capital markets ensure real rates of return are equalized. In this setting, the capital-labor ratio is pinned down by the world real rate of interest, which means an inflow of capital will be accompanied by an equal outflow of capital. In the end, therefore the capital-labor ratio is unaffected, and so is GDP.

5. This is a fairly open question. The key is though that the policy needs to target factors of production that are complementary to physical capital. In the case where the policy raises the marginal product of capital, inflows of foreign investment should follow to equalize returns. In

the course, we have discussed a number of complementary factors: Health, Education and technology (transfer/diffusion), as well as the role of misallocation. Policies that increase any of the aforementioned factors, or reduces the extent of misallocation in the economy, will potentially raise MPK and attract capital from abroad.