Written Exam at the Department of Economics summer 2020

Development Economics

Model Solution

August 18, 2020

(3-hour open book exam)

Problem A

Please provide short answers to the following questions and statements:

1. Empirically, there is a strong negative correlation between fertility rates and income per capita across countries. One explanation could be that higher income works to reduce fertility. Provide a theoretical argument for why rising income may lower fertility.

This question is related to Weil ch. 5 and PRLB ch. 7.

There are several reasons why rising income may lower fertility. A model solution for one primary reason is given here. Refer to PRLB ch. 7 (p. 234-235) or Weil ch. 5 (p. 110-113).

When wages rise, there are two direct effects on the number of children that a household will want. First, the so-called income effect means that households can afford to raise more children. This will tend to increase fertility. Second, having a child is relatively more expensive, since the foregone earnings by having a child also increases. This so-called substitution effect may dominate the income effect.

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2. Please explain which of the following income distributions is more unequal:
    a. (2,4,5,7,10)
    b. (3,3,5,7,10)

This question is related to Ray ch. 6.

The Pigou-Dalton principle states that distribution B is more unequal than distribution A if distribution B can be constructed from distribution A through a series of income transfers from person i to person j, where person i is poorer than person j.
Since distribution a in the question can be constructed by transferring an amount of 1 from the poorest person to the second poorest person, distribution a is more unequal than distribution b.

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3. Please briefly discuss which market failures may explain credit rationing.

This question is related to Ray ch. 14.

There are two main market failures that can lead to credit rationing:
- **Imperfect enforcement:** Imperfect enforcement leads to a risk of strategic default, i.e. a situation where the borrower simply decides not to pay back the loan. In a model where strategic default implies that the borrower cannot borrow again next period (or faces a higher interest rate), credit rationing can reduce the risk of strategic default by reducing the benefit to the borrower of such a move.
- **Informational asymmetries:** Lenders may not be able to observe how risky it is to finance projects. If borrowers whose projects fail can easily default on their debt, projects that are more risky (i.e. a higher chance of failing) but have a higher expected return in case of non-failure, can accept a higher interest rate. However, if a lender has enough money to lend out to e.g. one project, he or she may not be interested in raising the interest rate to a level that means that less risky projects will not be financed. This is because the lender receives zero in the case of failure. Instead, the lender may choose to set an interest rate that is low enough that he has some probability of lending out to a less risky project. However, this also means that in equilibrium, i.e. at the going

interest rate, some projects will not be financed.

4. What is the primary source of differences in health and income across countries, according to the "income view"?

This question is related to Weil ch. 6.

Health is an increasing function in income and income is also an increasing function of health. The equilibrium levels of income and health in countries depend on these two functions. The "income view" argues that differences between countries' income-health equilibria are caused by other aspects of production than health, e.g. physical capital and technology.

5. Please describe briefly what a randomized control trial is and discuss what the main advantage of using randomized control trials in development economics is.

This question is related to Barret and Carter (2010). Similar material is discussed in PRB ch. 8 (around p. 286).

A randomized control trial (RCT) is an experiment, where researchers aim to determine if an intervention works. In an RCT, a randomly selected group receives an intervention (also called the treatment group) and another randomly selected group is only observed (also called the control group). By observing differences in outcomes between the treatment and control group, it is possible to determine whether the intervention worked.
The main advantage of RCT's is that since the groups are randomly selected there should be no differences between the treatment and control groups in absence of an intervention. Therefore, any observed differences can be attributed to the intervention. This means that an RCT has the potential to get rid of fears of endogeneity, such as self-selection into the treatment or reverse causality.

6. Please explain how tamper-proof cameras can be used to achieve better schooling outcomes.

This question is related to PRLB ch. 8.

The quality of schooling in developing countries may be low for a number of reasons. One of these reasons is teacher absence. When schools are remote, it can be difficult to monitor whether teachers show up to teach. Tamper-proof cameras can reduce teacher absence by making pay contingent on teachers getting a student to take daily photos of the teacher together with the rest of the class. These photos can then be evaluated centrally at the end of the month.
In a randomized control trial, tamper-proof cameras were found to reduce teacher absence rates substantially and increase test scores of children in the schools where the cameras were used.

Problem B: Agriculture

1. Please describe how the following aspects of agriculture in developing countries can restrict agricultural productivity.
    a. A failure in the insurance market for agricultural output.

     b.   An unequal distribution of land.

This question is related to Ray ch. 11, 12 and 13.

Failure in the insurance market can lead to sharecropping. Sharecropping is a phenomenon where a person rents a plot of land for the price of a share of the produced output. Since only a fraction of the marginal product of the person who rents the plot accrues to him/her, that person will tend to reduce labor input. This reduces production, compared to when the person owns the plot, or the plot is rented out for a fixed price. Since sharecropping reduces the rental price when the harvest is poor, sharecropping may be preferred by risk-averse renters of land, especially if insurance against poor harvests is not available.

An unequal distribution of land can impact productivity in several ways.
First, land can be used as a collateral to obtain credit. Therefore, an unequal distribution of land may imply that more households will be credit constrained, which can reduce output per worker.
Second, there is some evidence that smaller farms tend to be more efficient. If this is the case, an unequal distribution of land may lead to lower efficiency, since some farms will be very large.
Third, if there is involuntary unemployment because some workers are not able to sustain a high level of work output due to a low level of work capacity at the prevailing (piece) wage rate, a land reform may increase labor supply due to an increase in work capacity at the prevailing wage rate.

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2.   Suppose agricultural productivity increases. Using the neoclassical two-sector model proposed by Eswaran and Kotwal as an analytical framework, what are the effects of this on sectoral labor allocation and on economic growth?

This question is related to PRLB ch. 16.

In the two-sector model of Eswaran and Kotwal, the wage in both the agricultural and the modern/industrial sector is determined by the marginal product of labor in agriculture. Increasing productivity in agriculture will increase the marginal product of agriculture, leading to higher wages in both sectors. Landlords also receive a higher rent on their land. However, it also increases food supply as well as the demand from landlords (and the now more well-off workers) of industrial goods ("textiles"). Together, this means that agricultural labor is now able and willing to leave agriculture and work in the industrial sector instead.

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3.   Please discuss how the term "backward linkage" relates to the model of Eswaran and Kotwal. How can the strength of backward linkages be analyzed empirically?

This question is related to PRLB ch. 16.

A "backward linkage" in this setting denotes the economic effect of increased demand from agriculture for products from the rest of the economy when agricultural production grows. So in the Eswaran-Kotwal model, it is the effect that agricultural workers demand more industrial goods when agricultural productivity increases.

If this linkage is strong, an increase in agricultural production will tend to increase economy-wide production by more than 1:1. This linkage is an example of a growth multiplier. Growth multiplier analyses

aim to measure the strength of such linkages by investigating how much GDP increases when agricultural production increases. There is evidence that the backward linkage is the dominant effect that increases growth multipliers in developing countries above one.

4. Please give a brief overview of how climate change may affect agriculture and how this in turn can affect poverty.

This question is related to PRLB ch. 16 and 20 and Hallegatte and Rosenberg (2017).

Climate change can impact agricultural productivity. The two primary channels through which climate change affects agriculture are higher average temperatures and changes in rainfall. There are regional differences in how agricultural productivity will be affected. The local effects depend on, among other things, which crops are grown and how temperature and rainfall changes. The effects also depend on which adaptation measures that are taken.

Agricultural growth has been found to be an effective tool for poverty reduction. Therefore, reductions in agricultural productivity due to climate change may have adverse impacts on poverty.

Hallegatte and Rosenberg (2017) estimate the effects of climate change on poverty through five channels, where two of the channels are related to agriculture, namely the effect on income for farmers and the effect on food prices for consumers. A decrease in agricultural productivity will reduce income for farmers. A reduction in food output will increase prices, which hurts consumers. The authors find that these two channels can increase the number of people below the poverty line. The agricultural channels have the largest potential impact on poverty of the five channels examined by the authors.

Problem C: Growth and development

1. The Solow growth model augmented with human capital and population growth can be described using the equations *(i)* - *(iv)*. Please explain the economic intuition behind the equations. Please be as precise as you can.

$$f(k_t) = Ak_t^\alpha h_t^{1-\alpha} \ (i)$$

$$\Delta k_t = i_t - d_t \ (ii)$$

$$i_t = \gamma * f(k_t) \ (iii)$$

$$d_t = (n + \delta)k_t \ (iv)$$

This question is related to Weil ch. 3 and 6 and PRLB ch. 4.

(i)   Is a function for production/income per worker/capita in time period t, where the standard Solow model has been expanded with human capital, h. A is a total factor productivity parameter. k refers to the capital stock per worker. α is a parameter that controls the share of production that accrues to capital.

(ii)   Is an accounting equation for the change in the capital stock per worker between period t-1 and t. The change in capital stock per capita equals investments per capita, i, minus depreciation per capita, d.

2.   Please discuss whether the Solow Growth model is an adequate framework for understanding growth and development.

This question is related to Weil ch. 6 as well as PRLB ch. 2 and 4.

The Solow growth model is a useful tool for understanding economic growth. It provide insights into relationships between income and investment, savings, population growth, human capital as well as technological change. It also provides a theory of how the economy reaches a new steady state equilibrium as a result of changes in these variables. The production function of the Solow model allows us evaluate the relative importance of different production factors as well as to undertake growth accounting in order to analyze why some countries are rich and other countries less rich. However, there are also factors that can be important for growths that are left out, such as political stability or export-oriented policies. Further, a high income per capita is not equivalent with high living standards. One reason is that much income could be used for savings instead of consumption. While this may allow higher income tomorrow, it does not improve living standards today.

The Solow model is however not sufficient for understanding economic development. This is because economic development as a concept is broader than just economic growth. While many development outcomes are often correlated with economic growth (or income per capita in levels), the correlation is far from perfect. Other outcomes could, among other things, include poverty, inequality and education and health outcomes. These factors do not enter, or enter only as explanatory factors (rather than as important outcomes in their own rights), in the Solow model.

3.   Jones & Klenow (2016)[1] use an alternative approach to measure development, using equation 1 as their starting point. Please discuss the intuition behind their approach, referring to equation 1.

$$U = E\left[\sum_{a=1}^{100} \beta^a * u(C_a, l_a)S(a)\right] \quad (1)$$

This question is related to Jones & Klenow (2016).

Jones & Klenow (JK, 2016) use a framework of expected utility in order to make international comparisons of welfare across countries. The basic idea is to specify expected utility (U) as a function of discounted utility (u) over consumption (c) and leisure (l) over the course of a person's life. Yearly utility is discounted and summed over ages 1 to 100. β is the yearly discount factor and S(a) is the probability of being alive at age (a) – dead people get zero utility. This person is a fictitious person who does not know how her life will turn out. Thus, JK assumes that she will draw from the cross-sectional distributions of consumption, leisure

[1] Jones, C., & Klenow, P. (2016). Beyond GDP? Welfare across Countries and Time. The American Economic Review, 106(9), 2426-2457.

and mortality of a given country.

JK goes on to calculate a consumption-equivalent measure of the welfare of one country compared to another. JK do this by asking how much one must scale annual consumption in some country *i* in order to make the person indifferent between living in country *i* and in the US.

4. What are the benefits of using the method of Jones & Klenow? What criticisms can be raised against the Jones & Klenow framework?

This question is related to Jones & Klenow (2016) and PRLB ch. 2.

JK motivates their measure by noting that GDP is a flawed measure of economic welfare, in part due to the reasons discussed in question 3 and also discussed in PRLB ch. 2. Like GDP, it is possible to compute using widely available data and it allows for international comparisons. Compared to a GDP measure, the JK measure has several benefits, including:
- Focusing on consumption instead of income – this allows JK to differentiate between those countries who spend much of their income on savings, compared to consumption.
- Negative effect of inequality is built in: Because JK assumes decreasing marginal utility within a framework of expected utility, inequality affects the consumption-equivalent welfare measure negatively.
- Compared to other attempts at international welfare measurements such as the HDI index, the JK approach is grounded in economic theory.

JK also discuss caveats to their approach, including:
- Using a single utility function for all countries, even though this may not be realistic
- Life expectancy is used as a measure of health and morbidity is ignored, even though it may well affect utility
- There are other factors of life than consumption and leisure that may plausibly enter the utility function. JK mention the quality of the natural environment, public safety, or political freedom, although there may be others.

5. The main results table of Jones & Klenow is shown in table 1. Please discuss the main findings of the table. In your discussion, you may focus only on the first row for each country (i.e. ignore the "micro" results).

This question is related to Jones & Klenow (2016).

The table shows the main results of JK. The first column shows the consumption-equivalent measure, λ, as compared to the US. The second column shows the income level relative to the US. The third column is the log-ratio between λ and the relative income levels. The remainder of the columns decompose this ratio into its component parts.

JK's discussion includes the following findings:
- There is a substantial correlation between GDP per capita and λ.
- Differences in "welfare", i.e. λ, relative to the US, are smaller for Western European countries than for differences in income relative to the US. This is primarily caused by higher life expectancies in Western Europe

- Differences in welfare relative to the US are larger for most poor countries than differences in income. There are several reasons for this, including lower life expectancies, lower consumption shares of income as well as higher consumption inequality in many of the included poorer countries.
- The conclusion from these two last findings is that global inequality in welfare (between countries) is higher than global inequality in income.