Written Exam at the Department of Economics summer 2020

Development Economics

Model Solution

May 25, 2020

(3-hour open book exam)

Problem A

Please provide short answers to the following questions and statements:

1. Why might GDP fail to measure annual value added in a country? Why might GDP be a bad indicator of "Economic Development"?

This question is related to PRLB ch. 2.

There are measurement issues related to GDP. Further, GDP may not capture all aspects of development.

Measurement issues include:

- Non-market production is not included, but must be imputed based on e.g. surveys. This is a particularly salient problem in developing countries, where production for own consumption is widespread
- Illegal activites and the shadow economy are usually not counted, although they do often provide economic value

Reasons for why GDP is not development include:

- GDP does not capture non-monetary outcomes such as health, education and clean water supply (although GDP does tend to be correlated with many of these outcomes)
- GDP does not capture social "bads" and externalities such as pollution or drawdown of natural ressources
- GDP does not say anything about inequality, and is therefore not informative about the level of poverty

2. Please explain briefly the difference between exchange rate conversion and PPP conversion of GDP. Which is preferred – and why?.

This question is related to PRLB ch. 2.

When converting GDP's using exchange rates, the GDP's measured in local currencies are simply converted into e.g. US dollars using the market exchange rate. However, this does not take account of the fact that the same good may cost different amounts of exchange-rate converted US dollars in different countries. This is particularly true for non-traded goods, often services, where prices in developing countries are often lower than in developed countries.

To counteract this, PPP indices have been constructed. These use US prices to production in other countries at the product level to construct a conversion factor that does not undercount the value of non-traded goods in developing countries. For this reason, PPP indices are often preferred to market exchange rate conversion of GDP figures.

3. Please briefly explain how it can be argued that aid has little or no effect on growth.

This question is related to PRLB ch. 14. Note that this is an abbreviated version of one of the review questions related to foreign aid.

The effect of aid may be lower than expected if a substantial share of aid is wasted, either through non-productive investements or corruption and graft. The effect can also be reduced if capital investments built with aid money are not maintained. Finally, the effect of aid can be reduced if the receiving country does not have sufficient absorptive capacity, for instance due to shortages of skilled workers in government.

Aid can also have negative consequences for existing economic growth. First, aid can undermine private sector activity through a real appreciation of the exchange rate, so-called dutch disease. Second, aid can reduce domestic savings and investment, since the aid inflow offsets the need for some of the domestic savings. Third, recipients can become dependent on aid. This can be dangerous if aid flows are suddenly reduced. Finally, aid can weaken institutions that countries need to continue their process of development.

4. Please explain the special principal-agent problem for aid agencies.

This question is related to PRLB ch. 14.

The principal-agent problem for aid agencies stems from the fact that donors and the final recipients of aid are separated by distance as well as by a chain of institutions and transactions. The goals of the aid agencies (the principal) may not fully align with the incentives of those people and institutions who implement the aid programs (the agents). In many other cases, the final recipients can reward or penalize the agents in the middle through e.g. political action. However, this is rarely possible for those local institutions that implement aid programs. In sum, the principal-agent problem means that it can be difficult for donors to make sure that the aid ultimately benefits those that the aid was intended for.

5. Please explain how the relationship between wages and nutrition can lead to low-level equilibria in labor markets in very poor countries.

This question is related to Ray ch. 13.

The work capacity of poor people may be closely related their income through the so-called capacity curve. The capacity-curve describes an s-shaped relationship between income and work capacity. The implicit assumption is that all nutrition is closely correlated with income. The capacity curve is s-shaped since, at very low levels of nutrition, marginal nutrition goes into maintaining the body's resting metabolism and does not increase work capacity. Further, beyond a certain point, additional nutrition does not add more work capacity.

If we assume what wages are piece rates, i.e. a linear relationship between work capacity and income, for very low piece rates, the only equilibrium between the s-shaped capacity curve and wage income may be at the lower part of the curve. The intuition is that income is so low, that a higher work capacity is not sustainable.

6. Please define the "growth multiplier" for agriculture and explain why it may be larger than 1.

This question is related to PRLB ch. 16.

The growth multiplier is an attempt to answer the question: "If Agricultural value added increases by $1, how much does the country's GDP increase?". The growth multiplier is the answer to this question.

The growth multiplier may be larger than one due to sectoral linkages between agriculture and the rest of the economy, which means that agricultural value added gives rise to additional value added outside agriculture. A good answer should mention one or more of such potential linkages. A particular important linkage is increased demand from agriculture for products from the rest of the economy.

Problem B: Inequality and poverty

1. Please give an overview of why inequality is considered to be important for development.

Several reasons why inequality is important has been discussed during the course. The most important are:

Inequality matters for poverty. This discussion should be based mainly on PRLB ch. 6. It is also discussed in Ravallion (2018). Keeping the average income level constant (i.e. in the absence of economic growth), an increase in inequality will result in an increase in poverty. Likewise, if economic inequality is constant and the average income level increases, poverty will decline.

Inequality matters for social welfare. This discussion should be based on Jones and Klenow (2016).[1] Using a framework of expected utility, Jones and Klenow show how inequality in a country plays a role in the expected utility of citizens of that country. The reason is that Jones and Klenow assume that marginal utility is declining in income. Therefore, a high level of inequality reduces expected utility, since the (expected) disutility from low income is higher than the (expected) utility from having a high income.

Inequality matters for economic growth. This discussion should be based mainly on Weil ch. 13. There are several channels through which inequality can affect economic growth. A good answer should mention several of these. The channels include:

- **Through savings and investment.** Richer families are thought to have higher savings rates. This implies that higher inequality leads to higher savings. If savings are identical to investment, this leads to higher levels of capital, which, in a standard Solow model, leads to higher levels of output.
- **Through investments in human capital.** For low quantities of investment, the returns to human capital may be higher than the returns to physical capital. If human capital is not transferrable, lowering inequality may increase investments in human capital. This will then lead to an increase in output. This can be thought of as a gain from allocative efficiency.
- **Through income redistribution.** High levels of inequality may increase the political need for redistribution through taxation. However, taxation distorts incentives, which reduces growth.
- **Through sociopolitical unrest.** High levels of inequality may increase sociopolitical unrest. The risk of destruction of output and loss of capital ownership reduces expected investment returns, which lower investments. This reduces output.

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

- **Through intergenerational mobility.** When parents material circumstances are important for opportunities of their children, higher inequality reduces growth, since the potential of some children will be wasted. This is also discussed in Aiyar & Ebeke (2019).[2]
- Finally, we note that economic growth and development are not necessarily identical. Nonetheless, there is often a high degree of correlation between other indicators of development and the level of e.g. GDP. Therefore, when inequality matters for growth, it also matters for development.

2. The four standard scientific rules guiding choices of inequality measures are:
    1. The anonymity principle
    2. The population principle
    3. The relative income principle (also referred to as the scale independence axiom)
    4. The transfer principle (or the Dalton/Pigou-Dalton principle).

    Please explain the four rules in the context of an inequality measure of the incomes of *n* individuals, $I(y_1,y_2,..,y_n)$.

The answer to this should be based mainly on Ray ch. 6.3.2.

The anonymity principle states that it does not matter for measures of inequality who earns which level of income. It implies that we do not need to concern ourselves with any other characteristics of the individuals than their income. It means that we can rank individuals from poorest to richest. Formally, this means that different permutations of the income distribution give the same measure of inequality.

The population principle states that population size does not matter. This implies that inequality measures should not be sensitive to the number of individuals in the income distribution. Formally, we can show this can be translated into saying that if we clone the entire population, inequality should be unchanged. Formally, this implies that $I(y_1,y_2,..,y_n)= I(y_1,y_2,..,y_n,y_1,y_2,..,y_n)$,

The relative income principle states that only relative incomes matter, the absolute levels of income do not. Formally this implies that $I(y_1,y_2,..,y_n)= I(\lambda y_1, \lambda y_2,.., \lambda y_n)$ for $\lambda>0$.

The transfer principle states that a transfer of income from one individual to an individual with more income increases inequality. Formally this implies that $I(y_1,y_2,.. y_i,\dots y_j,\dots y_n)< I(y_1,y_2,.. y_i-\delta,\dots y_j+\delta,\dots y_n)$ where $\delta>0$ and incomes are ranked from lowest to highest.

3. Please discuss how global inequality has evolved over the period 1990-2010. Please draw on the "elephant" and "serpent" graphs of Ravallion (2018) , reproduced in figure 1, for your answer.

This answer should be based mainly on Ravallion (2018), although an answer that draws on PRLB ch. 6 (namely figure 6-9) is also accepted. In the following, a model solution for an answer based on Ravallion (2018) is provided.

Ravallion shows a figure of total global inequality, i.e. a Theil measure of individual-level relative inequality for the period of 1990-2010. For the This measure has declined, especially since 2000. Total

[2] Aiyar & Ebeke (2019): The missing link between income inequality and economic growth: Inequality of opportunity. https://voxeu.org/article/inequality-opportunity-income-inequality-and-economic-growth.

global inequality can be decomposed into inequality between countries and inequality within countries. The majority of total global inequality stems from inequality between countries. The decline in total global inequality is driven by a decrease in inequality between countries

The "elephant graph" of figure 1a is a so-called growth-incidence curve. The curve shows the real income change in percent for the period 1988-2008 for different percentiles of the global income distribution. The figure shows that income gains were particularly high for the middle class of the developing world (around the 50th and 60th percentile) as well as for the very top of the global income distribution. However, growth rates were lower for the poorest part of the global income distribution and almost zero for the the world's lower-middle class (around the 80th percentile). This uneven growth across the income distribution means that the Lorenz curves for 1988 and 2008 intersect internally. Therefore, while the Theil measure of Ravallion's figure 1, as well as a gini measure, shows a decrease in inequality, other measures of relative inequality that are Lorenz consistent, i.e. abide by the rules of question 2, can show an increase.

The "serpent graph" of figure 1b is also a growth-incidence curve. However, the y-axis now shows *absolute* income growth over the period of 1988-2008. It becomes clear, that the top part of the income distribution had the largest absolute gains in income. Therefore, it is not surprising that measures of absolute inequality, i.e. measures where the relative income principle is done away with, have been increasing over this period.

1. Those at the bottom of the global income distribution live in absolute poverty. Please discuss some stylized facts about how the poor tend to spend their money – and discuss potential causes for these spending patterns.

This question refers to Banerjee and Duflo (2007).[3] The stylized facts about how the poor presented in this paper include:

The poor do not put all their money towards food. Of the money spent on food, the poor do not tend to maximize calories, but rather spend money on better quality, instead of simply focusing on caloric quantity. Banerjee and Duflo (BD) argue that this shows that the poor do not see additional calories as the only necessary item to spend their limited income on. BD also argue that additional nutrition may not help the poor much in terms of increasing their productivity.

A relatively large share of spending on luxury goods such as alcohol, tobacco and festivals and other social events. On the contrary, the poor spend very little on other types of entertainment such as movies or, in some countries, television ownership. BD hypothesize that festivals etc. may have crowded out other forms of entertainment – or perhaps these modern types of entertainment are simply not available or it is not feasible to save for e.g. purchasing a television,

The poor save little. BD propose several hypotheses for this stylized fact, namely that the poor lack a safe place to put their savings and that savings from home can be stolen, or that the poor can easily be tempted to spend their savings if they do start saving.

The poor invest little in education. BD argue that the children of the poor are to a large extent primary school (which is free in most of the developing world). They also argue that it may not be obvious to

[3] Banerjee, A. and Duflo, E. The Economic Lives of the poor. Journal of economic perspectives.

parents that the quality of the free primary schooling provided is often not good. Therefore, the poor do not prioritize sending their children to better and more expensive schools.

Problem C: Productivity

1. Please explain how the figures of "development accounting" in table 1 are constructed. Be as precise as you can.

This question is related to Weil ch. 7. Development accounting takes its point of departure in the Solow production function per worker, augmented by human capital. Below, this function is shown for country *i:*

$$y_i = A_i k_i^{\alpha} h_i^{1-\alpha}$$

We now compare output in countries *i* and *j* (which produces using the same production function) by taking the ration between output in the two countries:

$$\frac{y_i}{y_j} = \frac{A_i}{A_j} * \frac{k_i^{\alpha}}{k_j^{\alpha}} * \frac{h_i^{1-\alpha}}{h_j^{1-\alpha}} \ (I)$$

In this way, output per worker can be decomposed into three terms, namely differences in productivity, differences in capital per worker and differences in human capital per worker. Since all the terms of (I) except productivity can be observed, the productivity term can be residually determined.

Table 1 shows the different terms of equation (I), where the *j* = the US.

2. Please discuss which conclusions can be drawn from the results of table 1. Please also discuss any caveats related to the validity of the conclusions.

This question is related to Weil ch. 7.

First, productivity differs substantially between developed and developing countries. These differences are larger than differences in the factors of production available to different countries. In particular, human capital only differs by a factor of two between the countries of table 1.

Second, different countries have different strengths: for instance, Japan has more physical capital than the US, but lower productivity and about the same factors of production.

Third, we note that the measure of human capital is average years of schooling and that this measure is flawed since it does not capture differences in schooling quality.

Fourth, we note that the measure of physical capital may be flawed due to measurement errors in the stock of physical capital. In particular, the presence of graft and corruption may mean we overestimate the stock of physical capital.

Fifth, we note that the results are dependent on the functional form of the production function and the choice of α. A different functional form could yield different results. This point is not mentioned in Weil, but is discussed by Jerzmanowski (2007).

3. Jerzmanowski (2007) examines a case where all differences in productivity are due to differences in efficiency. Please discuss how it is possible to measure efficiency using the concept of a production frontier. Please draw on figure 2 for your answer.

Given a set of observations of different countries' factor use and output, a production frontier can be constructed as the convex hull of these observations. This gives an estimate of the highest level of production that can be attained for a given level of factor input.

Figure 2 illustrates a production frontier in the simple case of a single input (k). For a country observation not at the production frontier, the vertical distance between the observation and the convex hull gives a measure of inefficiency: It should be possible for the country to produce at the production frontier, and any differences from the frontier can be attributed to inefficiencies.

4. Productivity is often considered to reflect technology and efficiency. Please give a summary of the reasons why efficiency may be lower in developing countries than in developed countries.

This question is related to Weil ch. 10.

Types of inefficiencies include:

- **Unproductive Activities**. These activities include rent seeking through different types of regulation that protect certain businesses or sectors, but lower overall welfare. They also include nonproductive spending such as spending on security and avoidance of e.g. tax payments.
- **Idle resources**. This include labor unemployment or underemployment as well un- or underemployed capital. Idle resources can also take the form of some workers being paid to work even though they are in fact not working. This can be the result of e.g. government regulation or of bloated state-owned enterprises.
- **Misallocation of factors**. If the marginal product of production inputs are not equalized across sectors, a reallocation of input can increase aggregate output (also called allocative efficiency). There can be several reasons for why factors may be misallocated, including barriers to mobility, lack of firm dynamics, misallocation of finance and monopoly power.
- **Technology blocking.** This occurs when a technology could feasibly be used – but is not used because someone prevents its use. This is often done in order to gain a dominant market position (i.e. monopoly power) and extract monopoly rents.

5. Even when technologies are available, they may not always be adopted.
    a. Please explain how the findings of Atkin et al. (2017) is an example of this.
    b. Please discuss the broader implications of Atkin et al.'s findings for the prospects fo economic growth in developing countries.

Atkin et al. investigate the introduction of a new technology in a cluster of soccer ball-producing firms in an Indian city. The new technology is feasible to use from a technological standpoint and reduces overall

costs by reducing the amount of material that is wasted when soccer ball material is cut from larger pieces of fabric.

The authors intervene by introducing the new technology to a sample of the soccer ball-producing firms. However, the authors are surprised to learn that the technology is not adopted. The authors argue (and support by running a second experiment) that this is caused by a market failure within the firm: The cutters of soccer ball fabric are paid a piece rate. The new technology, while cutting costs overall, slows down the cutters, and they are therefore hesitant to use it since it reduces their wages.

Atkin et al. hypothesize that firms in developing countries may often face different types of organizational barriers, which can be costly to identify and overcome, that hinders technology adoption