

# 1 Homework #1

Table 1

	Value of output (in pelas)	Price in pelas	Price in the US (\$)
cars	100	10	10
wheat	50	2	1.5
housing	180	30	32
meals	75	1	1
clothing	100	2	2

1. **PPP adjusted dollars (PPP\$).** Consider the economy of Dolores whose currency is the pela. Dolores produces five goods. Last year's value of production for each of the goods, measured in the local currency, is shown in Table 1. Table 1 also shows the price of each good in Dolores (in pelas) and the price of each good in the US (in dollars).

- (a) Calculate GDP of Dolores in pelas.

The answer is in the spreadsheet. GDP in pelas is the sum of the value of output for the five goods, 505.

- (b) Calculate the PPP (purchasing power parity) index for each good.

The PPP index is calculated by dividing column 3, price in US\$, by column 2, price in pelas.

- (c) Calculate Dolores' GDP in PPP\$.

Calculate the value for each product in PPP\$ by multiplying value in pelas by the PPP index. GDP in PPP\$ is the sum of the value of output of the five goods, 504.5.

Table 2

	Life Expectancy	Adult Literacy	Enrolment Ratio	GDP per capita
Canada	79	99	99	22,480
Norway	78.1	99	95	24,450
United States	76.7	99	94	29,010
Turkey	69	83.2	61	6,350
Armenia	70.5	98.8	72	2,360
Dominican Republic	70.6	82.6	66	4,820
Ethiopia	43.3	35.4	24	510
Niger	48.5	14.3	15	850
Sierra Leone	37.2	33.3	30	410

2. **Human Development Index (HDI).** Table 2 shows Life expectancy at birth (years), Adult literacy rate (%), Combined first-, second-, and third-level gross enrolment ratio (%), and GDP per capita (PPP\$) in

**PROBLEM 1**

	<b>Value (pelas)</b>	<b>price (pelas)</b>	<b>Price (US\$)</b>	<b>PPP index</b>	<b>Value (US\$)</b>
cars	100	10	10	1	100
wheat	50	2	1.5	0.75	37.5
housing	180	30	32	1.07	192
meals	75	1	1	1	75
clothing	100	2	2	1	100
<b>GDP</b>	<b>505</b>				<b>504.5</b>

**PROBLEM 2**

	<b>Life Expectancy</b>	<b>Adult Literacy</b>	<b>Enrolment ratio</b>	<b>Education Index</b>	<b>GDP per capita</b>	<b>Utility</b>	<b>Life deprivation</b>	<b>Education deprivation</b>	<b>Income deprivation</b>	<b>deprivation index</b>	<b>HDI</b>
Canada	79	99	99	99.0	22480	10.020	0.00	0.00	0.06	0.02	0.98
Norway	78.1	99	95	97.7	24450	10.104	0.02	0.02	0.04	0.03	0.97
USA	76.7	99	94	97.3	29010	10.275	0.06	0.02	0.00	0.02	0.98
Turkey	69	83.2	61	75.8	6350	8.756	0.24	0.27	0.36	0.29	0.71
Armenia	70.5	98.8	72	89.9	2360	7.766	0.20	0.11	0.59	0.30	0.70
Dominican	70.6	82.6	66	77.1	4820	8.481	0.20	0.26	0.42	0.29	0.71
Ethiopia	43.3	35.4	24	31.6	510	6.234	0.85	0.80	0.95	0.87	0.13
Niger	48.5	14.3	15	14.5	850	6.745	0.73	1.00	0.83	0.85	0.15
Sierra Leone	37.2	33.3	30	32.2	410	6.016	1.00	0.79	1.00	0.93	0.07

1997 for nine countries: three high-income countries, three middle-income countries, and three low-income countries. Using only the information provided,

- (a) calculate the life expectancy deprivation index, the education deprivation index, and the GDP deprivation index for each of the nine countries. Use a log utility function to introduce diminishing marginal returns to income.

Answers in the spreadsheet. The education indicator is calculated as a weighted average of adult literacy (*weight* = 2/3) and enrolment ratio (*weight* = 1/3). It did not matter if you reverse the weights of literacy and enrolment (this is just an example). The sixth column shows the natural logarithm of GDP per capita for each country.

The maximum life expectancy is 79 for Canada and the minimum is 37.2 for Sierra Leone. Thus, the life deprivation index for Norway, for instance, would be  $(79 - 78.1)/(79 - 37.2) = 0.022$ .

Likewise, the maximum education indicator is 99 for Canada and the minimum is 14.5 for Niger. Therefore, the education deprivation index for Turkey would be  $(99 - 75.8)/(99 - 14.5) = 0.275$ .

For income, the maximum of the “utility” (column 6) is 10.275 for the USA and the minimum is 6.016 for Sierra Leone. The income deprivation index for Ethiopia would be  $(10.275 - 6.234)/(10.275 - 6.016) = 0.949$ .

- (b) calculate the deprivation indicator for each country.

The deprivation indicator is the average of the three deprivation indices.

- (c) calculate the HDI for each country.

HDI equals one minus the deprivation indicator.

3. An economy has the per-worker production function

$$y = k^{0.5}$$

where  $y$  is output per worker and  $k$  is the capital-labour ratio. The depreciation rate is 0.1, and the population growth rate is 0.05. Saving is

$$S = 0.3Y,$$

where  $S$  is total national saving, and  $Y$  is total output.

- (a) What are the steady-state values of the capital-labour ratio, output per worker, and consumption per worker?

The saving/investment rate is 30% and  $\alpha = 0.5$ . Therefore, the steady state value of the capital-labour ratio (capital per worker) is

$$\begin{aligned} k^* &= \left( \frac{s}{n+g} \right)^{1/(1-\alpha)} = \left( \frac{0.3}{0.1+0.05} \right)^{1/0.5} = 4. \\ y^* &= (k^*)^{0.5} = 2. \\ c^* &= (1-s)y^* = 0.7 \times 2 = 1.4. \end{aligned}$$

The rest of the problem shows the effects of changes in the two fundamental determinants of long-run living standards.

- (b) Repeat part **a.** for a saving rate of 0.4 instead of 0.3.

$$\begin{aligned} k^* &= \left( \frac{s}{n+g} \right)^{1/(1-\alpha)} = \left( \frac{0.4}{0.1+0.05} \right)^{1/0.5} = 7.111 \\ y^* &= (k^*)^{0.5} = 2.667 \\ c^* &= (1-s)y^* = 0.6 \times 2.667 = 1.6. \end{aligned}$$

- (c) Repeat part **a.** for a population growth rate of 0.08 (with a saving rate of 0.3).

$$\begin{aligned} k^* &= \left( \frac{s}{n+g} \right)^{1/(1-\alpha)} = \left( \frac{0.3}{0.1+0.08} \right)^{1/0.5} = 2.778 \\ y^* &= (k^*)^{0.5} = 1.667 \\ c^* &= (1-s)y^* = 0.7 \times 1.667 = 1.167. \end{aligned}$$

4. According to the Solow model, how would each of the following affect consumption per worker in the long run (that is, in the steady state)? Explain.

- (a) The destruction of a portion of the country's capital stock in a war. (Your answer should include graphs) This is a shock and, therefore, it does not affect the steady state—neither the saving rate or the population growth rate changes permanently. The country goes through a period of rapid growth in which it is rebuilding the stock of capital but eventually returns to the same steady state.
- (b) A permanent increase in the rate of immigration (which raises the overall population growth rate).

The country moves towards a new steady state with lower capital per worker and, thus, lower output per worker and lower consumption per worker.

(c) A temporary rise in the saving rate.

If the rise is temporary, it is a shock. The first effect of a temporary rise is an increase in the capital/labour ratio but, if the investment effort is not maintained, the country will go through a period of negative (low) economic growth to return to the old steady state. There is no change in consumption per worker in the long run.

(d) A permanent increase in the fraction of the population in the labour force (the population growth rate is unchanged).

This is a shock and therefore it does not affect the steady state. In this case, the growth of the labour force is not permanently changed, only its level is permanently changed. The first effect of an increase in the fraction of the population in the labour force is to lower the capital/labour ratio. The country goes through a period of rapid growth while the capital/labour ratio returns to its old level. The economy returns to the same steady state.