ECON304: Intermediate Macro
PS-1-FR Solutions

1. Assume an economy with two firms. Firm A produces wheat and Firm B produces bread. In a given year, firm A produces 50,000 bushels of wheat, sells 20,000 bushels of wheat to firm B at \$3 per bushel, exports 25,000 bushels of wheat at \$3 per bushel, and stores 5,000 bushels as inventory. Firm A pays \$50,000 in wages to consumers. Firm B produces 50,000 loaves of bread, and sells all of it to domestic consumers at \$2 per loaf. Firm B pays consumers \$20,000 in wages. In addition to the 50,000 loaves of bread consumers buy from firm B, consumers import and consume 15,000 loaves of bread, and they pay \$1 per loaf for this imported bread. Calculate gross domestic product for the year using

   (a) the value-added approach

   (b) the expenditure approach

   (c) the income approach

   Answer:

   (a) Value-Added approach: Firm A produces 50,000 bushels of wheat, with no intermediate goods inputs. At \$3 per bushel, the value of Firm A's production is equal to \$150,000. Firm B produces 50,000 loaves of bread at \$2/loaf, which is valued at \$100,000. Firm B pays \$60,000 to firm A for 20,000 bushels of wheat, which is an intermediate input. Firm B's value added is therefore \$40,000. GDP is therefore equal to:

$$\begin{aligned} \$Y &= 50,000(\$3) + [50,000(\$2) - 20,000(\$3)] \\ &= \$190,000 \end{aligned}$$

   (b) Expenditure approach: Consumers buy 50,000 loaves of domestically produced bread at \$2/loaf and 15,000 loaves of imported bread at \$1/loaf. Consumption spending is therefore equal to $\$100,000 + \$15,000 = \$115,000$. Firm A adds 5,000 bushels of wheat to inventory. Wheat is worth \$3 per bushel, so investment is equal to \$15,000. Firm A exports 25,000 bushels of wheat for \$3 per bushel. Exports are \$75,000. Consumers import 15,000 loaves of bread at \$1/loaf. Imports are \$15,000. Net exports are equal to $\$75,000 - \$15,000 = \$60,000$. There is no government spending. GDP is therefore equal to:

$$\begin{aligned} \$Y &= \$115,000 + \$15,000 + \$60,000 \\ &= \$190,000 \end{aligned}$$

   (c) Income approach: Firm A pays \$50,000 in wages. Firm B pays \$20,000 in wages. Total wages are therefore \$70,000. Firm A produces \$150,000 worth of wheat and pays \$50,000 in wages. Firm A's profits are \$100,000. Firm B produces \$100,000 worth of bread. Firm B pays \$20,000 in wages and pays \$60,000 to Firm A for wheat.

Firm B's profits are $\$100,000 - \$20,000 - \$60,000 = \$20,000$. Total profit income in the economy equals $\$100,000 + \$20,000 = \$120,000$. GDP is therefore equal to:

$$\begin{aligned} \$Y &= \$70,000 + \$120,000 \\ &= \$190,000 \end{aligned}$$

2. Consider an economy that produces only broccoli and cauliflower. In year 1, 1500 million pounds of broccoli are produced and consumed at \$0.50 per pound and 300 million pounds of cauliflower are produced and consumed at \$0.80 per pound. In year 2, 2400 million pounds of broccoli are produced and consumed at \$0.60 per pound and 350 million pounds of cauliflower are produced and consumed at \$0.85 per pound.

   (a) Using year 1 as the base year, calculate the GDP price deflator in years 1 and 2, and calculate the rate of inflation between years 1 and 2 from the GDP price deflator.

   (b) Using year 1 as the base year, calculate the CPI in years 1 and 2, and calculate the CPI rate of inflation. Explain any differences in your results between parts (a) and (b).

Answer: Price and quantity data are given as the following:

Year 1		
Good	Quantity (million lbs.)	Price (per lb.)
Broccoli	1500	\$0.50
Cauliflower	300	\$0.80

Year 2		
Good	Quantity (million lbs.)	Price (per lb.)
Broccoli	2400	\$0.60
Cauliflower	350	\$0.85

(a) In order to calculate the GDP price deflator in years 1 and 2, first calculate both nominal and real GDP for both years ($BY = 1$). Nominal GDP in each year is given by

$$\begin{aligned} \$Y_1 &= 1500(\$0.50) + 300(\$0.80) \\ &= \$990 \\ \$Y_2 &= 2400(\$0.60) + 350(\$0.85) \\ &= \$1737.50 \end{aligned}$$

Assuming year 1 is the base year, real GDP in each year is given by

$$\begin{aligned} Y_1^1 &= \$Y_1 = \$990 \\ Y_2^1 &= 2400(\$0.5) + 350(\$0.80) = \$1480 \end{aligned}$$

Thus, the GDP price deflator in years 1 and 2 are

$$P_1^1 = 100 \quad P_2^1 = \frac{\$1737.50}{\$1480} \times 100 = 117.4$$

Therefore, the rate of inflation (the percentage change in the GDP deflator) is

$$\pi_2 = \frac{P_2^1 - P_1^1}{P_1^1} = 17.4\%$$

(b) Year 1 production (market basket) at year 1 prices equals year 1 nominal GDP ($\$Y_1 = \$990$). The value of the market basket at year 2 prices is equal to

$$1500(\$0.60) + 300(\$0.85) = \$1155$$

Thus, the CPI in years 1 and 2 are

$$\text{CPI}_1 = 100 \quad \text{CPI}_2 = \frac{\$1155}{\$990} \times 100 = 116.7$$

Thus, the CPI rate of inflation is 16.7%. The relative quantities $(2400/1500, 350/300)$ have increase more than the relative prices $(0.6/0.5, 0.85/0.8)$. Thus, the CPI shows less inflation, since it is based on a fixed basket.

3. For each of the following production functions, determine and prove whether they exhibit constant, increasing, or decreasing returns to scale.

   (a) $Y = K^{0.6}N^{0.2}$

   (b) $Y = K^{0.7}N^{0.3}$

   (c) $Y = K^{0.8}N^{0.4}$

   Answer:

   (a) For any real number x,

$$\begin{aligned} Y(xK, xN) &= (xK)^{0.6}(xN)^{0.2} \\ &= x^{0.6}K^{0.6}x^{0.2}N^{0.2} \\ &= x^{0.8}K^{0.6}N^{0.2} \\ &= x^{0.8}Y(K, N) \\ &< xY(K, N) \end{aligned}$$

   which validates that this production function exhibits decreasing returns to scale.

   (b) For any real number x,

$$\begin{aligned} Y(xK, xN) &= (xK)^{0.7}(xN)^{0.3} \\ &= x^{0.7}K^{0.7}x^{0.3}N^{0.3} \\ &= xK^{0.7}N^{0.3} \\ &= xY(K, N) \end{aligned}$$

   which validates that this production function exhibits constant returns to scale.

   (c) For any real number x,

$$\begin{aligned} Y(xK, xN) &= (xK)^{0.8}(xN)^{0.4} \\ &= x^{0.8}K^{0.8}x^{0.4}N^{0.4} \\ &= x^{1.2}K^{0.8}N^{0.4} \\ &= x^{1.2}Y(K, N) \\ &> xY(K, N) \end{aligned}$$

   which validates that this production function exhibits increasing returns to scale.

4. Given a reduction in the savings rate, s, in the Solow growth model, answer the following questions:

   (a) Graph the effects of the change in s.

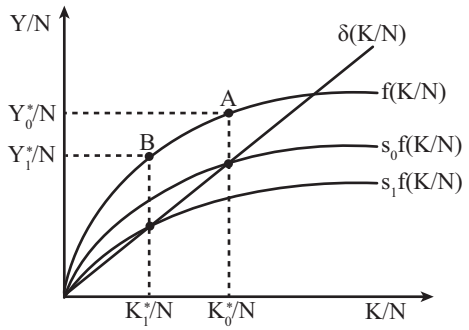
   (b) On impact, what happens to K/N, Y/N, S/N, and C/N?

   (c) What are the

   - **short-run** effects on the growth rate of Y/N?
   - long-run effects on the **growth rate** of Y/N?
   - long-run effects on the **level** of Y/N?

Answer:

(a) The following graph depicts a reduction in the savings rate from s_0 to s_1.



The lower s causes a reduction in saving, S, and an increase in consumption, C, since, at time t agents income has not yet changed. It takes one period for the change in saving/investment to affect capital; consequently K/N and, therefore, Y/N do not change in period t.

(b)
- At the initial K/N, with the lower savings rate, s_1, investment is now less than depreciation. Thus, K/N and, therefore, Y/N will fall over the short run. The capital stock, and hence output, slowly falls until the new steady state equilibrium is reached. In other words, the short run growth rate of output per worker is negative.
- Once the new steady state is reached, denoted point B, Y/N remains constant. The lower s has no long run effect on the growth rate of Y/N.
- It permanently reduces the level of Y/N in equilibrium.

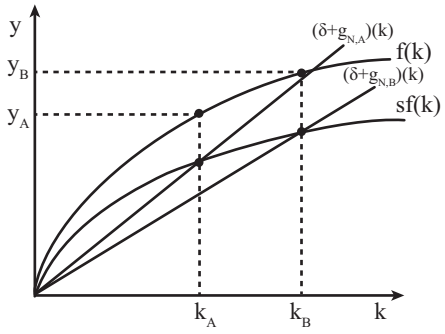
5. Suppose that two countries are exactly alike in every respect except that population grows at a faster rate in country A than in country B.

   (a) Which country will have the higher level of output per worker in the steady state? Illustrate graphically.

   (b) Which country will have the faster growth rate of output per worker in steady state?

   Answer:

   (a) Country B will have the higher level of output per worker. In the figure below, lower case letters denote variables per effective worker, e.g., $k = K/(AN)$. Also because this question is about a difference in population growth, it is safe to assume that both countries have no technological growth, $g_A = 0$.



   (b) In steady state, the growth rate of output per worker will be zero in both country A and country B.