

## Problem 1 (60%)

Consider the following data on output, physical capital and human capital per worker.

	Output per worker	Physical capital per worker	Human capital per worker
United States	1	1	1
Norway	3/2	4	1
South Africa	1/10	1/3	1/3

Assume that the production function in all three countries is

$$Y = AK^\alpha (hL)^{1-\alpha},$$

where  $Y$  is output,  $A$  is productivity,  $K$  is physical capital,  $h$  is human capital and  $L$  is employment. All variables may differ across countries except  $\alpha$ , which is assumed to be 1/2.

- What is the economic interpretation of  $\alpha$ ?
- Derive the intensive form of the production function.
- Calculate productivity in Norway and South Africa.  
Which country is more productive, Norway or the U.S.?

d) Imagine that research and development in Norway increased productivity by 50 percent. What would Norwegian output per worker be after the productivity increase?

e) A South African government official asks whether low output per worker is explained by low productivity or low levels of factors of production. What would you say?

f) Describe briefly the role of productivity and factors of production in explaining income differences across countries (not in the context of this numerical example, but in general).

g) The government official asks whether we can expect South African output per capita to grow because of accumulation of physical capital. Analyze this question in the context of the Solow model. You can assume that: (i) the savings rate is 50 percent of output ( $\gamma = 1/2$ ), (ii) depreciation of physical capital is  $3/10$  ( $\delta = 3/10$ ), (iii) the production function is identical to above, (iv) there is no population growth, no growth in productivity  $A$ , and no growth in human capital  $h$ . Hint: Calculate steady state capital per capita and compare to the current level of capital per capita.

## Problem 2 (40%)

Consider two countries, Norway and Sweden. Norway and Sweden can produce milk and salmon. The number of hours worked to produce one unit of each good is

	Norway	Sweden
Milk	2	1
Salmon	1	2

Consumers spend half their income on milk and the other half on salmon. The population size of Norway and Sweden is identical. The remaining assumptions of the Ricardian model hold.

a) Define opportunity cost and comparative advantage. What is the opportunity cost of milk in Norway and Sweden? Which country has a comparative advantage in milk production?

b) Imagine that international trade in milk and salmon is impossible. Explain why the price of milk relative to salmon,  $p_M/p_S$ , is 2 in Norway and  $1/2$  in Sweden.

c) Imagine that international trade is now free. Draw the relative supply (RS) and relative demand (RD) curve. Explain each curve and provide economic intuition.

d) The price of milk relative to salmon under free trade,  $p_M/p_S$ , is 1. Which country exports which product?

e) Draw budget lines for individuals in Norway before and after the opening of trade. Are they better or worse off?